



Agricultural Colleges
AND
Experimental Farm Stations

With suggestions relating to Experimental
Agriculture in Canada.

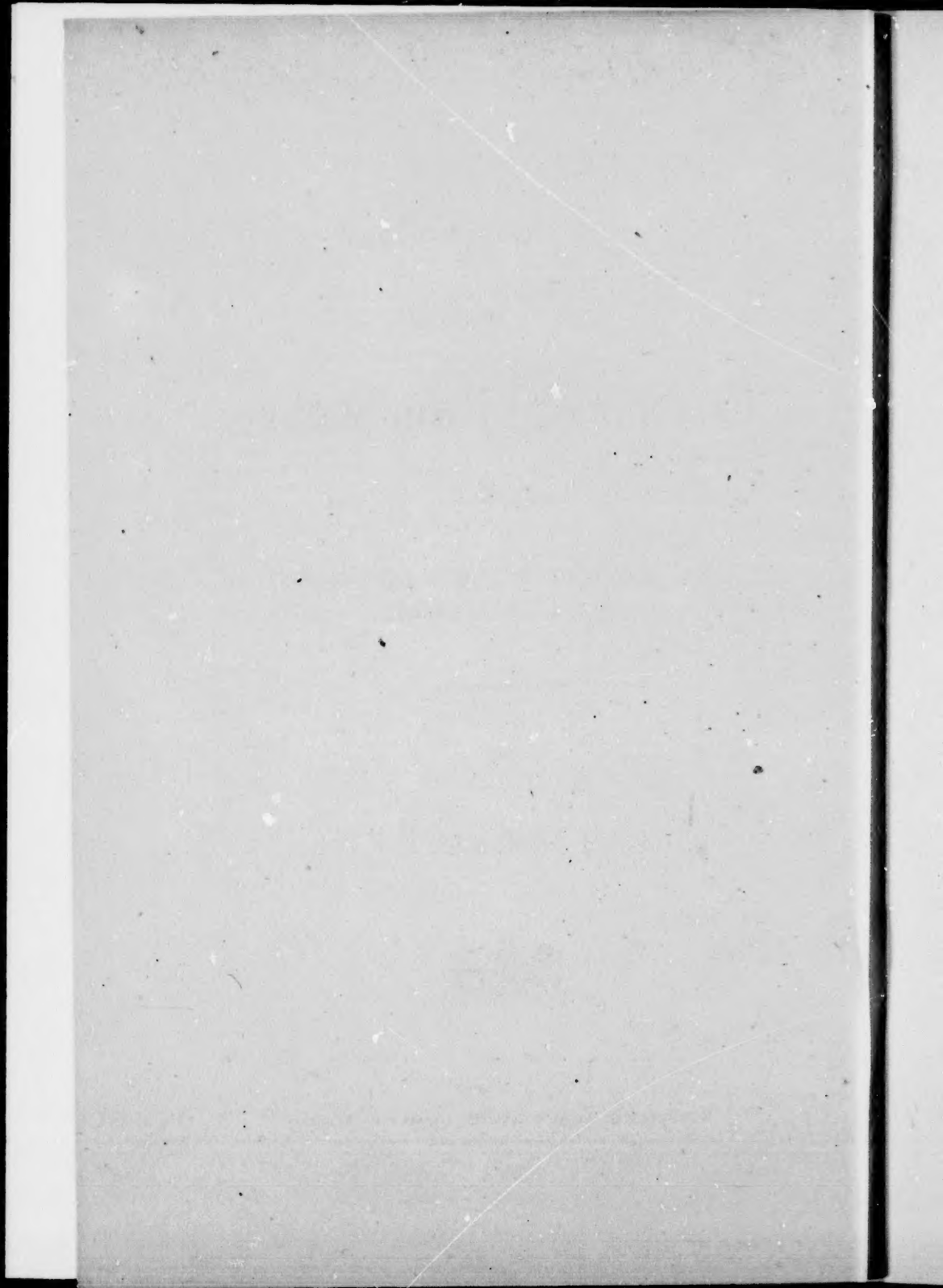
BY
Professor Saunders, F. R. S. C.



OTTAWA:

Reprinted from the Appendix to the Report of the Minister
of Agriculture for 1885.

1886



- CONTENTS -

Instructions to and Reply of Prof. Wm. Saunders.....	PAGE 1
I.—AGRICULTURAL COLLEGES AND EXPERIMENTAL STATIONS IN THE UNITED STATES.	
Alabama	6
Arkansas.....	6
California	6
Colorado.....	8
Connecticut.....	9
Delaware.....	11
Georgia.....	11
Illinois.....	12
Indiana.....	18
Iowa.....	20
Kansas.....	28
Kentucky.....	32
Louisiana.....	32
Maine.....	33
Maryland.....	37
Massachusetts.....	38
Michigan.....	41
Minnesota.....	43
Mississippi.....	44
Missouri.....	46
Nebraska.....	46
Nevada.....	47
New Hampshire.....	47
New Jersey.....	47
New York.....	49
North Carolina.....	52
Ohio.....	53
Oregon.....	56
Pennsylvania.....	57
Rhode Island.....	58
South Carolina.....	58
Tennessee.....	59
Texas.....	59
Vermont.....	59
Virginia.....	60

	PAGE
West Virginia.....	61
Wisconsin.....	61
WASHINGTON (FEDERAL GOVERNMENT).....	62
FORESTRY (Letter from Mr. Bernhard E. Fernow, New York, Secretary of the American Forestry Congress).....	64
Forestry Expenditure in Germany.....	72
II.—AGRICULTURAL COLLEGES, EXPERIMENTAL STATIONS AND SCHOOLS OF HORTICULTURE AND FORESTRY IN EUROPE.	
ENGLAND :	
Royal Agricultural College at Cirencester.....	73
Downton College of Agriculture.....	75
FRANCE.....	76
GERMANY :	
The Royal Agricultural Academy at Poppelsdorf, near Bonn, Prus- sia.....	77
The Royal Institute for Fruit and Wine Culture.....	78
BELGIUM :	
The Royal Forest School of Bavaria.....	79
Agricultural Experimental Stations.....	80
The Horticultural School at Ghent.....	81
OTHER COUNTRIES.....	81
III.—AGRICULTURAL EDUCATION AND EXPERIMENTAL WORK IN CANADA.	
ONTARIO.....	84
QUEBEC.....	91
NOVA SCOTIA.....	92
NEW BRUNSWICK.....	92
DOMINION DEPARTMENT OF AGRICULTURE.....	93
Exports.....	94
IV.—GENERAL CONCLUSIONS AND RECOMMENDATIONS.	
PRELIMINARY.....	97
DIVISION OF EXPERIMENTAL AGRICULTURE :	
Proposed Organization and Management.....	98
Considerations of Advantage.....	101
Opinion of Dr. George M. Dawson.....	107
FORESTRY.....	110
GENERAL SUMMARY.....	110

PAGE
61
61
62
ry
64
72
LS

73
75
76

us-
77
78

79
80
81
81

NADA.
84
91
92
92
93
94

97
98
101
107
110
110

*A REPORT ON AGRICULTURAL COLLEGES AND
EXPERIMENTAL FARM STATIONS*

• WITH SUGGESTIONS RELATING TO

Experimental Agriculture in Canada

BY PROF. WILLIAM SAUNDERS, F.R.S.C.

LONDON, ONT., 20th February, 1886.

SIR,—I had the honour to receive in due course the following letter written under your direction :—

“ DEPARTMENT OF AGRICULTURE,
“ OTTAWA, 2nd November, 1885.

“ SIR,—I have an instruction from the Minister of Agriculture to state to you, that, having in view to put into effect the vote of last Session for the purpose of establishing an experimental farm, he will be glad to avail himself of your services to obtain certain preliminary information.

“ There was, as you are aware, a Select Committee appointed by the House of Commons in the Session of 1884, of which Mr. Gigault was the Chairman, to enquire into the best means of encouraging and developing the agricultural interests of Canada. That Committee did take evidence on the subject of the establishment of an experimental farm, and made a report in favour of such a project. A copy of that report is sent to you herewith.

“ There are, however, some further points on which the Minister desires to obtain information in connection with this question; and he would, therefore, feel obliged if you would

have the goodness to visit as many of the more important agricultural colleges, experimental farms and experimental stations in the United States and Canada, as you may think necessary, for the purpose of enquiring into the various methods of working; and with a view of ascertaining as far as possible what benefits, either direct or indirect, they are conferring on practical agriculture, including stock raising, dairying, etc.; and, also, of ascertaining what is being done in horticulture, especially in regard to the production of fruit.

"It is further desired by the Minister that you should incidentally enquire into the subject of forestry, to ascertain, as far as practicable, the extent and character of tree-planting in the Western States, the varieties chiefly used, and the success which has attended the efforts which have been made.

"It is also desired that you ascertain the areas of land occupied by the several institutions you may visit, the character of the soil and equipments, with capital cost; together with the expense of maintenance.

"The Minister desires that you should prepare and submit, as early as practicable, a report on the whole subject, indicating what features of the work, if accomplished, would, in your opinion, be most particularly beneficial to the agricultural, horticultural, and, incidentally, to the forest interests of the Dominion of Canada.

"I have the honour to be, Sir,

"Your obedient servant,

"JOHN LOWE,

"Secretary, Department of Agriculture.

"Wm. Saunders, Esq.,

"London, Ont."

In compliance with the request contained in this letter, I have recently visited many of the agricultural colleges and agricultural experimental stations in the United States, for the purpose of enquiring into the methods by which they are conducted, with a view of ascertaining, as far as possible, what benefits, either direct or indirect, they are conferring on

practical agriculture, including stock-raising, dairying, etc. I have also endeavoured to ascertain what is being done in horticulture, especially in regard to the production of fruit, and in forestry, with special reference to the extent and character of tree-planting in the Western States; also to gain information as to the area of land occupied by each institution, the character of the soil, buildings and equipments, the expenditure on capital account and cost of maintenance, together with such other particulars as were believed to be of sufficient importance to occupy your attention.

In addition to what has been accumulated as the result of direct personal enquiry, I have endeavoured to present a brief summary of some of the more important features of the work being done by similar institutions in those parts of the United States which the limited time at my disposal did not permit me to visit. Most of these particulars have been obtained by correspondence. Reference also is made to what is being accomplished in European and other countries in the same direction, so as to present, as far as practicable, the whole subject of agricultural progress in a concise form. This is accompanied by an outline of a proposed system embracing such features of the work as would, in my opinion, be most particularly beneficial to the great agricultural interests of the Dominion of Canada.

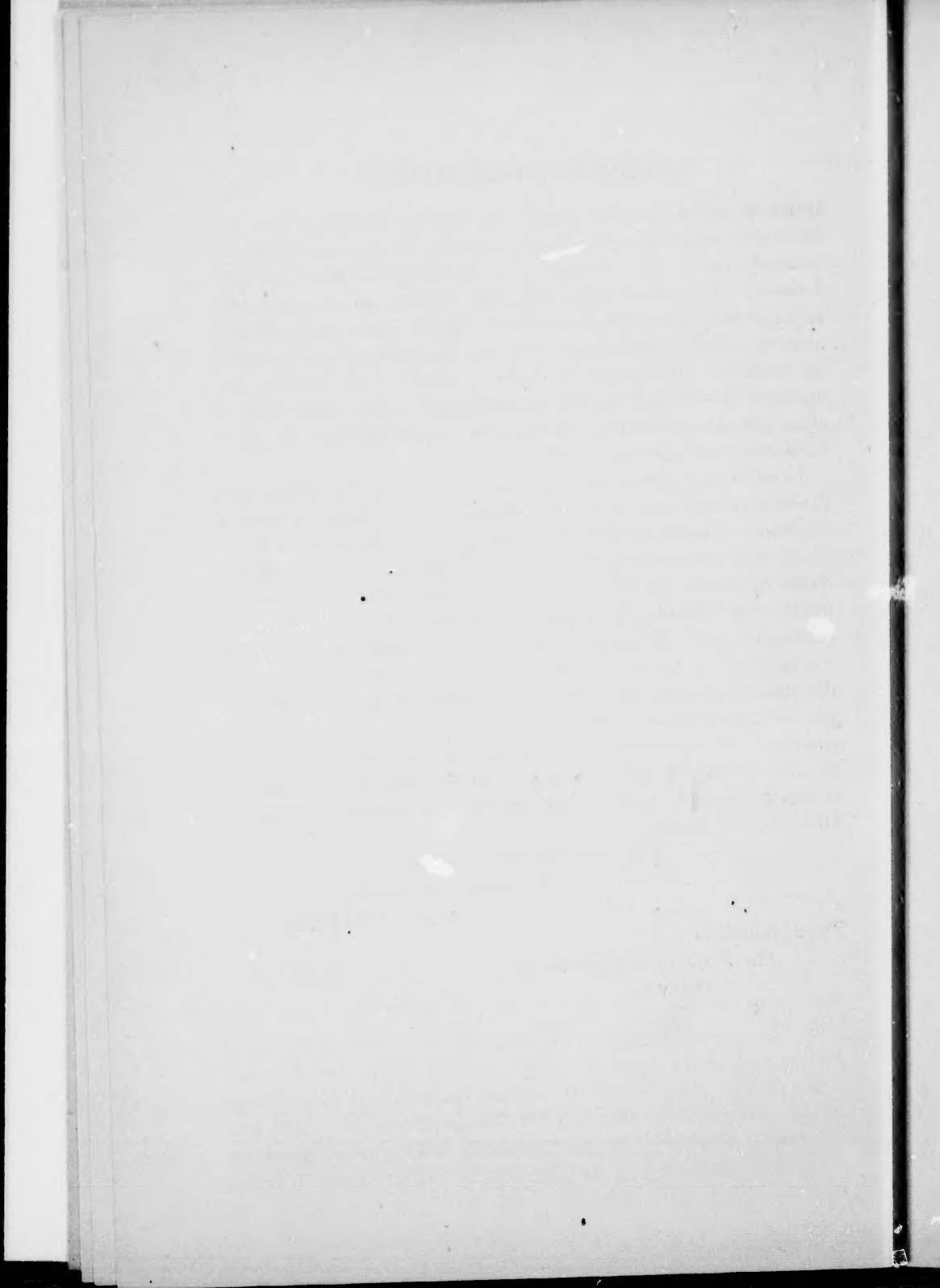
I have the honour to be, Sir,

Your obedient servant,

WM. SAUNDERS.

The Honourable

The Minister of Agriculture,
Ottawa.



REPORT

I.—AGRICULTURAL COLLEGES AND EXPERIMENTAL STATIONS IN THE UNITED STATES.

In the year 1861 the Congress of the United States, having in view the importance of encouraging the development and progress in that country of the two great departments of industry, passed an Act which provided for the endowment of a college of agriculture and mechanic arts in each State of the Union, by making a large grant of public lands for that purpose. The quantity apportioned to each State was equal to 30,000 acres for each senator and representative in Congress to which such State was respectively entitled by the apportionment under the census of 1860. The Act provided that the whole of the money received from the sale of these lands should be invested in safe securities, and the interest only used for the maintenance of the several institutions. The States were required to furnish the necessary land for the colleges, and no portion of the fund could be spent in the purchase, erection or repair of any building or buildings. These must be supplied by the State or by the liberality of the towns and cities near which the institutions were to be located.

In this way the foundation was laid for the providing of a substantial and permanent fund for the maintenance of each college; 9,600,000 acres of land were appropriated, from the sale of which a fund of nearly \$9,000,000 has accumulated, with a considerable quantity of land still unsold. The aggregate of the value of grounds, buildings and apparatus was given in 1882 at \$6,531,844, making a grand total of over fifteen and a-half millions of dollars devoted to furthering the development of these great national industries.

ALABAMA.

The Agricultural and Mechanical College of Alabama is situated near Auburn. The quantity of land occupied is 100 acres. The cost of the main building was \$65,000. There are separate structures for chemical laboratory, workshops, etc., the total value of grounds, buildings and apparatus being \$100,000. Endowment fund from sale of public lands, \$253,500; total revenue, \$22,500; expenses about the same.

Practical agriculture is taught in all its different branches, and an experimental field of twenty acres is devoted to the testing of fertilizers and experiments in the cultivation of field crops, fruits and flowers. The course of study covers four years, but very few of the students remain long enough to graduate. The students in the scientific and mechanical departments greatly outnumber those pursuing agriculture.

ARKANSAS.

The Industrial University of Arkansas, designed for imparting instruction in agriculture and mechanical arts, is located near the town of Fayetteville. The endowment fund is \$130,000; the land, buildings and appliances are valued at \$170,000. The annual income from the land grant is \$10,400, which is supplemented by annual appropriations from the State. The yearly expenditure is \$17,500, of which the salaries of the teaching staff consume \$15,500.

In connection with the agricultural department there is an experimental farm, also a chemical laboratory and museum.

CALIFORNIA.

The University of California obtained the agricultural college land grant on condition that special departments for the teaching of agriculture and the mechanic arts should be established and maintained there. The amount derived from this source was \$566,280, with land valued at \$26,860 still unsold. The University is a very extensive one, and is located at Berkeley. It has grounds, buildings and appliances valued at \$1,000,000, and a total endowment fund of \$1,678,386.

The annual income from the proceeds of agricultural college lands is \$39,226, a large proportion of which is devoted to agricultural teaching and experimental work. A course of lectures, combined with practical instructions, is given in agriculture, horticulture, botany and entomology, and a chemical laboratory is especially devoted to agricultural purposes. There are also three greenhouses, a nursery and propagating grounds, an arboretum and a garden of economic plants.

The orchards are large and include 150 varieties of apples, 140 of pears, 65 peaches, 55 plums; also a number of cherries, apricots and nectarines. The vineyard has 60 varieties of European grapes, in addition to a large number of American origin.

Experimental Station.—An experimental station has been in active operation for several years, under the efficient direction of E. W. Hilgard, Professor of Agriculture. Extensive experiments have been conducted with fertilizers in growing grain, forage plants, sugar cane, sugar beets, sorghum and other field crops. A large number of grapes have been introduced from all parts of the world, especially those varieties from which the most highly esteemed wines of Europe are made; also those from which the noted raisins of Chili and other countries are produced. Experiments have been made in grafting the best cultivated sorts of grapes on the wild vines of California and other thrifty growing stocks, for the purpose of ascertaining which will best resist the attacks of that injurious and troublesome insect, phylloxera, which has caused the California vinegrowers so much anxiety and loss. The insect, together with other injurious species, has also been studied, and measures suggested for its abatement and destruction.

Large numbers of forest trees have been introduced from Europe, Asia and Australia, which, besides being tested on the college farm, have been distributed to many intelligent persons in different parts of the State for trial. There has been an annual distribution of samples of grain and grasses from all parts of the world, also seeds of plants, young plants and

trees, scions of desirable fruit and other trees, with accompanying instructions for planting, grafting, etc. These are sent to applicants engaged in agriculture in the State in the order of their application, until the stock is exhausted, on receipt of sufficient money or stamps to cover cost of packing and mailing.

In the chemical department many analyses have been reported of wines of different grades, made in California, of soils and subsoils, including those of the more noted grape-growing districts; also of alkaline soils, of water from Artesian wells, and of stream and well waters from many parts of the State.

Notwithstanding all the educational advantages offered, we learn from a late report that out of a total number of 246 students only 17 were taking agriculture.

The results of the experimental work are brought promptly before the public by the issue of bulletins at intervals of from one to three weeks during the summer. These are mailed to newspapers, agricultural periodicals and to prominent agriculturists; also to the agricultural colleges and experimental stations of other States.

Since the coast climate of British Columbia is said to be much like that of the northern part of California, the experimental work carried on at this station becomes of special interest to Canada.

COLORADO.

The State Agricultural College of Colorado is located at Fort Collins, in the fertile valley of the Cache-la-Poudre River. It is endowed with 90,000 acres of selected lands, which have not yet been sold. The expenses of the institution are met at present by a special tax of one-fifth of a mill on State valuation, which gives it an income of about \$20,000 a year, a considerable portion of which is required for salaries of staff which range from \$1,000 to \$2,500. The college was opened in 1882, and occupies 240 acres of land; the land, buildings and appliances are valued at \$50,000.

The larger part of the college farm is under cultivation, the work being chiefly experimental, including the cultivation of fruit and forest trees, cereals, grasses, garden vegetables and small fruits. One hundred and fifty-one varieties of wheat and twelve of barley, received from Europe, Australia, New Zealand, California, Manitoba, Mexico and other places, have already been tested at this institution with great benefit to the State. A number of experiments with potatoes and other garden vegetables have also been conducted, a thrifty nursery and orchard have been established, several hundred small fruits and several thousand forest trees have been planted, and many tests made as to the germinating power of vegetable and flower seeds obtained from a number of different dealers.

The course of instruction in agriculture includes practical training in farm work.

CONNECTICUT.

The Sheffield Scientific School, which is one of the departments of Yale College, received the agricultural land grant on condition that it provided suitable and competent instruction in agriculture and the mechanic arts. The endowment fund from land sales amounts to \$135,000. The institution is situated in the town of New Haven, and the value of the grounds, buildings and apparatus is \$200,000. The course of instruction is very thorough in all the sciences bearing on agriculture, and lectures are given on the cultivation of staple crops, tree planting, etc.

Experimental Station.—Connecticut was the first State which established an experimental station in agriculture. This was originally located in the eastern wing of Sheffield Hall, where good work was done for several years. In 1879 the present efficient director of the station, Dr. S. W. Johnson, took charge of the work, and has conducted it in such a manner as to make it extremely useful to the agriculture of the State. At the outset the State appropriated \$5,000 a year for its maintenance, which has since been increased to \$8,000.

A special appropriation of \$25,000 was also made for the purchase of land, and for buildings and apparatus. There is also a special tax levied on fertilizers sold in the State, to aid in defraying the expense attending their analysis, which adds about \$2,500 to the yearly revenue of the station.

There are seven acres of land attached to the institution, which, with the buildings on it when purchased, cost \$12,000. A chemical laboratory has since been erected, at a cost of \$5,000 for the building and \$2,500 for fittings, including many of the most improved forms of apparatus required for carrying on this special work. Other structures have also been built. No stock is kept here; there are no greenhouses, and very little outside work has been done. The operations carried on have been mainly chemical, particularly in the line of the analysis of fertilizers, of which there are in Connecticut about 130 different brands in the market. The State laws require that at least one analysis shall be made every year of each brand, and the reports of the station work contain returns of the results of these analyses, averaging in number more than 150 each year. In addition to this, much work has been done in determining by analysis the relative value of mixtures for feeding purposes, fodders, etc., also in the analysis of milk and many other articles of food.

Another department in which good work has been done is in testing agricultural and commercial seeds, to determine their vitality and purity. The annual reports published by this station average about 120 pages, and are full of most valuable information. The yearly saving to the farmers of this State by the exposure of fraudulent and inferior brands of fertilizers has been very large, amounting to many times the cost of the maintenance of the station. The staff consists of two chemists, two assistants, two clerks and one gardener. The number of copies of the bulletins printed is from 5,000 to 6,000, which are distributed chiefly among farmers. The law requires also that two copies be sent to each postmaster in the State.

DELAWARE.

The agricultural department of Delaware College is situated at Newark. It has an endowment fund of \$83,000, and the land, buildings and appliances are valued at \$75,000. The total income is about \$5,500. The college does not own a farm, but courses of lectures are given on the principles and practice of agriculture, the composition of soils and fertilizers ; also in chemistry, botany and the kindred sciences.

GEORGIA.

The Georgia State College of Agriculture and Arts is a branch of the State University, and is located at Athens. The endowment fund from sale of agricultural lands amounts to \$242,202, which yields an annual revenue of about \$17,000. This is divided between several institutions, to be presently referred to, the State College receiving \$8,000. The land, buildings and appliances are valued at \$50,000.

A full course of instruction is given in agriculture, horticulture, botany, entomology, etc. There is also an experimental farm connected with the University, where the students receive practical instruction. Many very valuable experiments have been conducted on this farm with different sorts of cotton and corn, and the effects of fertilizers on the crops recorded. A large chemical laboratory, with all the necessary appliances, affords ample opportunities for the study of this branch of science, especially in its relation to agriculture. There is also a museum of agricultural products.

There are three other smaller agricultural colleges in Georgia, each of which receives \$2,000 annually from the endowment fund. They are known as the North Georgia Agricultural College, located at Dahlonega; the Middle Georgia Military and Agricultural College at Milledgeville; the Southwest Georgia Agricultural College, at Cuthbert; and the South Georgia Agricultural College, at Thomasville. These all provide instruction in agriculture, horticulture and kindred subjects.

ILLINOIS.

The University of Illinois is one of the best conducted and most efficient institutions which I have visited. It is located about midway between the towns of Champaign and Urbana. It has an endowment fund of \$337,000, realized from the sale of public lands, and the buildings, appliances and land are valued at \$400,000. The University buildings, which are fifteen in number, include a large and imposing main building, in which are the principal offices, class rooms, library, museum, chapel, etc. (towards the erection of this structure the State contributed \$127,000); a chemical building, containing five laboratories, erected at a cost of \$40,000; a veterinary hall; large machinery buildings, dormitories, etc. The land occupied by the University and its several departments embraces 623 acres.

Department of Agriculture.—There are devoted to the uses of the Department of Agriculture two farms, one of 410 acres, known as the "Stock Farm," and one of 180 acres designated the "Experimental Farm." The soil is prairie, dark coloured and fertile, well drained with about eleven miles of tile drains. For a number of years past these farms have been so worked as to give an annual profit of from \$1,000 to \$1,500. The acreage in various crops in 1855 on the stock farm was: corn, 105; oats, 65; meadow, 145; the remainder, pasture.

Stock.—From eight to ten horses are kept, part of which are used for breeding purposes. There are among them good specimens of French draught and general purpose horses.

The number of cattle will vary from 125 to 150 head. There is a good herd of Shorthorns, numbering about 70, a small herd of Jerseys, and a number of well bred grade cows of various crosses, including Holsteins, Herefords and Ayrshires, and steers of different ages, which are being fed for the market. The milk of the cows is used chiefly for butter making, the product being sold in the neighbouring towns.

There are small flocks of Shropshire, Cotswold and South-down sheep, and their crosses.

Of pigs, there are a number of the following breeds: Poland-China, Berkshire and small Yorkshire. Some attention is also given to breeding Plymouth Rock fowls.

Many experiments have been made in breeding and feeding cattle, sheep and pigs, the results of which have been published from time to time in bulletins and annual reports.

Field Experiments.—The experiments with field crops have been carried on for many years, and include the testing of a large number of varieties of corn to ascertain their relative yield and the best methods of cultivation; also experiments in fertilization and with special manures. Similar tests have been carried on with wheat, oats and other grain; also with grasses, potatoes and other field crops.

Experimental Farm.—In the experimental farm there are 35 acres of orchard. Fifteen acres are devoted to forest plantations; 40 acres to ornamental trees, shrubs and plants; a considerable area to small fruits, of which there are a large assortment, and a portion to vegetables. There is also a nursery, where young trees are grown and students are taught the arts of budding, grafting, etc.

Orchard.—This was planted in 1869, and included at the outset 1,800 varieties of fruit trees, gleaned from every quarter, with the view of testing their adaptability to the State of Illinois. As was anticipated, a large number of them were failures. Indeed, the climatic and other conditions of this section are not particularly favourable to fruit growing. The country is flat, and in many places wet, and difficult to drain, and the winters sometimes are severe. Many apples which are grown with profit in Ontario, such as Greenings, Baldwins, etc., do not succeed well here.

Pear culture has not been continuously successful. The trees did fairly well for ten or twelve years, but last winter the weather was so severe that a large proportion of them were killed, both standard and dwarf, although the latter suffered most. Plums have been unsuccessful. Out of many varieties originally planted there are now but very few left. No peaches or apricots are grown.

Of cherries there are a large number, chiefly of the Morello type, including many of Wier's seedlings, which do remarkably well. The sweet cherries belonging to the Bigarreau class are almost always killed before coming into bearing. Quinces are but little grown. Many sorts of grapes are raised, of which Worden stands highest in favour, Moore's Early and Ive's Seedling rank next. Delaware is a failure on black prairie soil, but does nicely on sandy ridges. Strawberries and raspberries are extensively grown, and with much success.

Forest Plantations.—The planting of forest clumps was begun in 1871, and at that time there were no trees in the district, except on the margin of streams. The example set by the agricultural department of the University has stimulated tree planting generally, both for ornament and shelter. The black walnut is a favourite tree, so also is the silver maple (*Acer dasycarpum*) and the box elder (*Negundo aceroides*.) A variety of cotton-wood (*Populus monilifera*) is much grown. This tree is a native, found on the bottom lands of the Missouri River from Arkansas to Nebraska, also in western Iowa. The wood splits well and is generally known as yellow poplar. It is much more useful than the ordinary cottonwood.

In the college forest plantations there are from one-quarter acre to two acres each of the following trees: white pine, Scotch fir, Austrian pine, Norway spruce, European larch, green ash, western catalpa, southern catalpa, black walnut, butternut, hickory, burr oak, ailanthus, honey locust, sugar maple, silver maple, American elm, osage orange, box elder, red cedar and chestnut. Of most of the varieties planted the failures have been so few as not to interfere materially with the general results. This forest planting was done chiefly under the late Dr. Warder's supervision, who was an advocate of close planting. The trees were planted in rows four feet apart and two feet apart in the rows, which experience has shown to be a waste both of trees and labour.

It is claimed that the box elder and western catalpa can be raised with more profit than any of the other trees on account

of their rapid growth. The catalpa is being extensively used for fence posts and railroad ties; the wood is more durable than is generally supposed; the sap wood quickly decays, but the heart wood is very lasting. The white pine trees in the college plantation have been quite a success, having attained, in twelve years from planting, a height of 25 feet, with trunks six inches in diameter at base. These trees were three or four years old from seed when planted.

The Scotch fir, eleven years planted, average about the same height, with larger trunks, measuring seven to eight inches at base. The sugar maples, which were three years old when planted, have an average diameter of trunk of four to five inches; while the silver maple has made from eight to ten inches in the same time. The box elder is still more thrifty, many of the specimens having reached a diameter of trunk of from 10 to 12 inches. The green ash has formed a handsome grove, with trees very uniform in height and size, the trunks ranging from six to eight inches in diameter.

Black walnut and butternut have both made fair growth, but have not grown with that rapidity which might have been expected. Another clump of black walnut, twenty years planted, on a different part of the farm, was also examined, and while there were a few fine trees, with trunks over a foot in diameter, the majority of them had not attained to more than nine or ten inches. The plantation of European larch is very fine, the trees being very uniform in growth, fully 25 feet high and about eight inches in diameter of trunk. In one small spot, where the land was low and wet, the trees were stunted and unhealthy in appearance. The chestnut trees have not been successful, but few now remaining of the original plantation, showing that they are not suited to this locality. The hickories have made very slow growth; so also have the burr oaks. The Austrian pine seemed somewhat stunted, although fair growth had been made in past years. This stunting was due, no doubt, to a disease which affected the leaves of the trees, causing many of them to wither and fall.

The white willow has attained a greater height than any of the other trees, having reached an altitude in thirteen years of 30 feet or more, and a diameter of trunk exceeding a foot at the base.

Shelter Belts.—Some excellent examples of shelter belts are to be found in the orchard, composed of Norway spruce trees, arranged in rows, so as to divide the orchard into five or six sections. No material advantage has been observed from the shelter afforded in the way of protecting trees from winter-killing, but protection from the prevailing winds has notably prevented the fruit from falling to the extent it otherwise would.

Conservatory.—Situated near the main building is a conservatory with three propagating houses, each 50 feet long, the middle one being fitted with extra pipes, so that a higher temperature can be maintained in it than in the others, and one of the outer ones is specially fitted up for propagating, by boxing in the water pipes so as to give additional bottom heat. In these buildings are propagated all the bedding plants needed for ornamenting the grounds. They contain also plants representing most of the different families required for the purpose of illustrating botanical lectures and class-work, as well as furnishing material and appliances for carrying on experimental work. Cut flowers are sold from these houses during the winter, and surplus plants in summer, but the revenue from this source rarely exceeds \$300 per annum, and entails commercial work, which interferes, to some extent, with the legitimate and more important aims of the institution.

Botanic Work.—The Professor of Botany, Prof. T. J. Burrell, has done good work in his department. While efficiently carrying on the class-work devolving upon him, he has also found time to thoroughly study many of the low forms of plant life, such as smuts, rusts, moulds, etc., many of which are parasitic on and frequently destructive to the higher forms of vegetation. The life history and habits of many of these have been carefully worked out, and suggestions made as to the best methods of lessening the injuries caused by

them. It is chiefly to this earnest worker that the credit is due of having solved the mystery which has so long surrounded that dreaded disease known as the fire blight in the pear tree; and since it has been demonstrated beyond reasonable doubt that it is caused by the presence and propagation in immense numbers of a very low form of vegetable life, a species of micrococcus, the way is prepared for intelligent experiment in the direction of measures for preventing the disease, a result which pear-growers will hail with the greatest delight.

Entomological Work.—Prof. S. A. Forbes, State Entomologist of Illinois, is now located at this University, where he holds the position also of Professor of Entomology and Zoology. With the help of several assistants, he is carrying on not only his teaching duties, which cover a very wide field, but is also pursuing many very interesting lines of experimental work. A careful examination of the results of observations made during the past year with regard to the codling worm in apples, which will be of great use, not only to that State, but to fruit-growers in all parts of America, had just been concluded at the time of my visit. The object was to determine the precise effect of the use of Paris green in preventing the destruction of the apple crop by this insect. The experiments with the remedy have been conducted along with careful check experiments, on trees adjacent, not treated at all, and exact results reached by the careful handling and examination of every apple produced on the trees under inspection. Over 16,000 apples have thus been carefully scrutinized, and the results show that about two-thirds of the loss arising from this source may be prevented by the use of Paris green.

Insects injurious to corn, which is the staple crop of Illinois, has absorbed a large part of the time and attention of the staff in this department for the past year, and an additional year or two of patient observation will be required to complete the work.

A multitude of facts have been brought together regarding the food of birds; also on the habits and food of fishes. An extensive and successful series of experiments have been made in the way of introducing disease among injurious caterpillars for the purpose of destroying them. Illinois was one of the first States to recognize the important bearing of entomology on agriculture, by the appointment of a State Entomologist; and the vast array of valuable facts which have been accumulated and given to the public in the annual reports of the several scientific men who have held the office during the past twelve or thirteen years, have abundantly justified the wisdom of that proceeding.

Revenue and Expenditure.—The total expenses vary from \$60,000 to \$70,000 per annum, of which the teaching staff receive about \$28,000. The salaries of the professors range from \$1,800 to \$2,000. That of the regent is \$3,600.

The farm has been so conducted for several years past that the revenue has exceeded the expenditure; but to bring about this result it has been necessary to reduce the proportion of experimental work, and to leave undone many things which should have been undertaken.

Conclusion.—Notwithstanding all the advantages offered in this institution to those desiring a thorough course in agriculture, out of a total number of 356 students attending during 1884, only twenty-one were preparing themselves for agricultural pursuits.

INDIANA.

Purdue University is located about one mile west of the City of Lafayette, on elevated ground overlooking the city and the surrounding country. John Purdue, after whom the University is named, bequeathed \$150,000 towards its establishment; the county in which it is located gave \$50,000; and the State appropriations have during the past twelve years amounted to \$168,000. The endowment fund from sale of land grants is about \$345,000, and the total value of land,

buildings and appliances is placed at \$3,0,000. The number of acres occupied is 190, valued at \$50,000.

School of Agriculture.—The school of agriculture, which is one of the important departments of this University, is carried on in a building specially erected for this purpose. Besides class rooms there are museums of agricultural, horticultural and forestry products, and a suitable library. The course of study is a very practical one, and associated with two hours' hand work each day, either on the farm or in the workshops.

The ornamental grounds contain about 2,500 trees and shrubs, and the conservatory and propagating house are filled with choice plants. These, with the orchard and nursery, offer all the needed facilities for practical instruction.

Experimental Farm.—On this farm many experiments have been conducted to ascertain the relative value of agricultural implements, in testing varieties of wheat, oats, corn, grasses and potatoes, methods and rates of seeding, effects of fertilizers, with comparisons as to relative vigour and ability to endure severe climatic changes. Experiments have also been undertaken with small fruits to ascertain their relative hardiness, vigour, productiveness and quality of fruit.

Chemical Laboratory.—In this department a considerable number of fertilizers have been analysed, and the results published, giving the manurial value of each on the basis of 10 cents per lb. for soluble phosphoric acid, 6 cents for reverted phosphoric acid, 5 cents for insoluble phosphoric acid, 15 cents for ammonia, and 6 cents for potash.

Revenue and Expenditure.—The total college revenue for 1884 was \$22,235, \$18,280 of which was from interest on endowment fund. The expenses were \$36,132, the balance being provided for by State appropriations. The salaries of the teaching staff amounted to \$18,000. The farm is so managed that the revenue more than covers the expenditure. This, however, cannot be done where much experimental work is undertaken.

Conclusion.—Bulletins of ten or twelve pages each are frequently issued during the season, giving promptly to the

farmers the benefit of the results of experimental work. The same complaint is made here as elsewhere, that notwithstanding all the facilities offered for obtaining a thorough agricultural training, very few farmers care to give their sons the benefit of it; hence the students in agriculture do not exceed six per cent. of the whole number receiving instruction.

IOWA.

The Iowa State Agricultural College is situated in the central county of the State, one and a half miles from the town of Ames, on the Chicago and North-Western Railway. It has an endowment fund from the proceeds of public lands of \$637,800, and the value of the land, buildings and appliances, is placed at \$1,000,000.

The college domain includes 700 acres, about 80 of which are devoted to buildings and ornamental planting, 40 acres to orchards, shrubbery, forestry plantations, etc. About 100 acres are under cultivation, 300 acres in woods, and the remainder in natural pasture.

The buildings are admirably situated on the highest portions of the college grounds, where they command an extensive view of the surrounding country. The main building is a substantial stone structure, 158 x 112, and four stories high. In the basement are the dining rooms and servants' quarters; on the first floor the library, containing 6,000 volumes; the chapel, and the offices of the teachers. The second floor is fitted up with lecture rooms and rooms for students, while the third and fourth floors, excepting the space occupied by the museum, are entirely devoted to the accommodation of students. About 200 can be lodged in this building, besides which there are brick buildings near at hand, known as boarding halls, which furnish dormitories for 90 additional students, with dining rooms, kitchens, etc.

The chemical laboratory, agricultural hall, horticultural hall, the veterinary building, where diseased animals are treated, the mechanical shops for working in iron and wood, and the school for domestic economy for women, are all in separate

buildings. They are commodious and substantial in their character, and have every appliance needed for carrying on the different branches of work for which they have been specially designed. There are also six detached dwelling houses, which are occupied by some of the professors.

Students entering this college are not obliged to take an agricultural course, but have the option of taking either a general course, which includes instruction in most of the important branches of learning, or either of the following special courses: agriculture, mechanical engineering, civil engineering, veterinary science or domestic economy. The result of this choice in studies is, that the larger proportion of students take the general educational course, and out of a total number of about 300, only thirty are at present taking the agricultural course; so that instead of this excellent institution being regarded as a special school of agriculture, it might be more correctly designated a school for higher education and general training in industrial pursuits, with a special department of agriculture. Nevertheless, it has done and is still doing most excellent work, both in agriculture and horticulture.

Stock.—The stock on the farm consists chiefly of Holsteins and Shorthorns. A herd of five pure bred young Holsteins was imported four years ago, at a cost of \$240 per head, belonging to a very good milking strain. These have been found very useful, both as milking stock and for beef. A number of young males have been produced, both pure bred and grades, and these have been sold to the farmers in the neighbourhood, whose stock has been greatly improved thereby. The Professor of Agriculture claims to have watched the effect of these grade males in improving the general stock of the farmer, and while he would not compare their power to transmit their peculiarities with that of pure bred males, he believes their potency has been underestimated, and that where the service of pure bred males cannot be had, that of half-bred grade males is infinitely better than that of males of common stock. A number of grade cows are also kept,

both for milk and feeding purposes, and many experiments have been conducted in feeding calves, pigs and sheep. The animals are provided mainly for teaching and experimental purposes, and are not specially needed for the improvement of stock in the State, as there are about 500 herds of thoroughbred cattle in Iowa, chiefly Shorthorns, Holsteins and Jerseys.

In experiments with sheep, Southdowns have been crossed with Shropshires, with the result of materially increasing the wool, adding two to three pounds to the fleece, while the quality of the mutton is said to have remained about the same.

Dairying.—Experiments in butter making are carried on here in a building specially designed for that purpose, and fitted with every necessary appliance. Tests are made of the milk of the several breeds of cattle kept, for the purpose of determining the quality and quantity of the butter, and how the yield is affected by variations in treatment.

The dairying interests of Iowa are very important, and there are a large number of creameries in different parts of the State, in some of which are manufactured from 4,000 to 5,000 pounds of butter per day during the best part of the season. In all cases the cream only is collected, the skim milk being kept by the farmers for feeding young pigs. Before the establishment of creameries butter was sold at an average of from 8 to 10 cents per pound, but as soon as creamery butter could be had the quality was so superior that the price went up to 20 cents, which is now about the ruling figure. This difference in price has added several millions of dollars yearly to the revenue of the State from this source. One serious difficulty in prosecuting this business arises from the long drives necessary to collect the cream, sometimes involving a circuit of forty miles. Iowa has about one-third of all the creameries in the United States. The cheese interest is comparatively small.

Field Experiments.—During the past few years many varieties of wheat, oats and corn have been tested; also many sorts of grasses for fodder, and a large proportion of the newer sorts of potatoes, as this is an important section of the

root crop in Iowa. Experiments have also been conducted in making sugar from sorghum.

The past year's work in potatoes includes the testing of the comparative value, both in productiveness and quality, of from eighty to ninety varieties. It has been observed that the newer sorts are much more vigorous in their growth, and have almost entirely escaped the rot which has seriously injured the older kinds. Roots are not much grown; bran, which can be bought at from \$8 to \$10 per ton, is thought to be cheaper as food for stock. This is alternated with potatoes, which, it is claimed, can be grown on rich prairie soil at a cost of about 6 cents per bushel.

Horticulture.—It is in horticulture that the work of this institution has been most pre-eminently useful. The climate of Iowa is particularly trying to fruit trees; the hot and dry weather of summer is very injurious to the foliage, while nothing but the hardiest character of wood will endure the extreme cold and bitter winds of winter. The hardiest varieties of apples grown in other States and in Canada will, as a rule, pass safely through the ordinary winters of Iowa, but an exceptionally cold season occurs every few years, which makes a clean sweep of most of them. Such apples as the Fameuse, Ben Davis, Talman's Sweet, Wealthy and Golden Russet, will be killed to the ground in many parts of the State during such extreme winters. These bitter experiences have led the horticulturists of that State to seek to introduce fruits from other quarters of the globe where the conditions of climate are somewhat similar. It had long been known that there were hardy varieties in European Russia. Indeed, America had long since received from that country several of the hardiest sorts now generally grown, such as the Duchess of Oldenburgh, Red Astrachan and Alexander. The Department of Agriculture at Washington had also succeeded in obtaining trees and scions of a number of other hardy Russian apples, through the American Consul at St. Petersburg, which had shown themselves possessed of great hardiness. But it was felt that a systematic exploration of the Russian fruit terri-

tory was necessary before it could be fully ascertained to what extent their hardy fruits would meet American needs. Correspondence was opened with the Agricultural College of Moscow and with the Director of the Botanic Garden at St. Petersburg, which led to the belief that there were varieties of apple, pear, plum and cherry, growing in the interior provinces of that great empire which, if introduced to this country, would be likely to make fruit growing possible among those who are carrying on agricultural operations in the extreme northern sections of America. Finally, the Iowa Agricultural College sent its Professor of Agriculture, Prof. J. L. Budd, to Russia, in 1882, and he was joined by one of our most distinguished Canadian horticulturists, Mr. Chas. Gibb, of Abbotsford, Quebec.

These two gentlemen were eminently fitted for their work, from their general knowledge of fruits and their intimate acquaintance with the requirements of the colder regions of this country. They spent several months during the fruit season, chiefly in the interior of Russia, where they visited many of the most noted fruit regions embraced within that immense territory.

Beyond the range of the Carpathian Mountains the explorers entered on the great plain known as the East European Plain, which includes that portion of Austria north and east of the Carpathians, and the greater part of Russia in Europe. This immense territory is bounded at the north by the frozen ocean, on the east by almost continuous plains, extending into Northern Asia, and on the west and south by the Baltic Sea and Gulf of Finland, the Caspian and the Black Seas. The mountain ranges on the south cause precipitation of the moisture, carried by winds which have passed over the inland seas, so that the eastern plain gets but little rain from this source; while the dry winds from the deserts and sterile steppes of the south-east shrivel the foliage of trees and plants in Central Russia, much as the south-west winds do in the Western States, coming from the dry plains of New Mexico. The immense swamps with which some portions of this terri-

tory are occupied, particularly in the west, modify the climate, making it vary greatly in different sections. As far north as Moscow the prevailing west winds give a fair percentage of moisture to the air, but in the same longitude, as far south as Orel, the summer heat and dryness of the air are similar to Western Iowa, while further east on the Volga the summer clime is much like Western Kansas and Nebraska, while the winters are as severe as those of Minnesota, with a scanty and uncertain snow-fall. Further east the climate is much more rigorous.

Soon after entering on this vast plain, the travellers observed a marked change in the character of the fruit trees, which appeared more decided as they approached the districts referred to. It was seen that the foliage became much thicker and leather-like, and better fitted to endure extremes of temperature and drought, while in size the trees were stunted. They penetrated to the interior, visiting several Provinces where fruit is grown on an extensive scale, and finally reached the Province of Kasan, about 430 miles north-east of Moscow, on the upper waters of the Volga. As they journeyed they frequently met with immense orchards, each containing from 10,000 to 25,000 trees, cultivated and cared for in the most admirable manner. In the Province of Vladimir they found that cherries were grown in very large quantities, so that during the fruit season whole trains were laden with them, carrying them to the Russian cities. They are described as "very prolific, about the size of the Early Richmond, nearly sweet, with a small stone, purple flesh, and nearly black when ripe."

Continuing eastward and northward, it was observed that the trees became more and more stunted in their growth, although still bearing good crops of fine fruit, until in the northern part of Kasan, which is probably the coldest apple-growing region in the world, the apple trees were reduced to the size of mere bushes, and were grown in clumps about 10 feet apart, with two, three and sometimes four little trees in a clump. At this point, 600 miles nearer the North Pole than

the city of Quebec, are several small villages, where one of the principal industries is apple growing, the value of the crop being estimated in favourable seasons at not less than \$50,000. The thermometer here frequently reaches 40° below zero, and is said in extreme weather to drop occasionally to 48° and even 58° . Much information was gained in reference to the quality of the different varieties of apples which have, during the past 600 or 800 years, been gradually acclimated to endure the severe tests to which they are exposed in this extreme climate, and arrangements were made for obtaining the most promising sorts to be tested in America. As results of this work, Prof. Budd has now growing in the experimental grounds of the Iowa Agricultural College more than 100 varieties of apples, about 40 of pears, 30 of plums, 40 of cherries, and several varieties of peaches and apricots, all from these cold regions. In addition, this collection includes a large number of the forest trees found in Russia, especially the more rapid growing varieties, as well as ornamental shrubs and trees; in all, about 100 sorts.

While spending a day with Prof. Budd, in looking over this large and interesting collection, and noting their growth and character, I was convinced that there are among them many varieties which would be of inestimable benefit to our North-West Territories, and which would, if introduced into Canada, enable us to enlarge very much the area of successful fruit culture in the northern parts of all the Provinces in the Dominion.

One very striking practical demonstration was afforded as to the hardiness of the Russian apples. Two adjoining orchards on the college grounds, similar in situation and soil, were planted some five or six years ago, one with about 1,200 trees, embracing 118 varieties of the hardiest apples to be found in America, including the Duchess of Oldenburgh (originally from Russia); the other with about 1,000 trees, consisting entirely of Russian sorts. The winter of last year was very severe in Iowa, and the result was that fully three-fourths of the trees composing the orchard of American

where one of
value of the
not less than
hes 40° below
tionally to 48°
a reference to
s which have,
ly acclimated
exposed in this
for obtaining
a. As results
n the experi-
ege more than
f plums, 40 of
ricots, all from
ion includes a
ussia, especially
amental shrubs

oking over this
eir growth and
ng them many
t to our North-
ed into Canada,
successful fruit
ovinces in the

was afforded as
Two adjoining
nation and soil,
with about 1,200
st apples to be
of Oldenburgh
out 1,000 trees,
ter of last year
hat fully three-
d of American

selection were killed. Chief among the survivors was the Duchess of Oldenburgh, with a few others, while in the adjoining orchard, composed entirely of Russian sorts, consisting of over 100 varieties, not a single dead tree could be found.

Since their introduction, Prof. Budd has propagated these trees with great industry, and has succeeded in establishing among the farmers and fruit growers throughout Iowa no less than 800 sub-stations where these fruits are being tested. Fifteen thousand apple trees were distributed in this way last year. Many of the apples are said to be of very good quality. Six varieties of the Duchess family have been fruited, which will extend the time of the Duchess period fully two months. The best sorts of Russian apples are said to improve in quality when grown in America. The Duchess of Oldenburgh is believed to be a finer apple here than it is in Russia; this idea is quite consistent with what we know of English apples cultivated in Canada. There are conditions in our climate or soil which develop in many English and other fruits a high flavour and quality unattained in their native home.

Forestry.—Forest clumps and shelter belts have been successfully established at several points on the college farm, and the trees are growing thriftily. All that portion of Iowa through which I passed bore evidence of the interest taken by the people generally in forest planting. On a large proportion of the farms more or less land is devoted to that purpose, and clumps of young forest trees, varying in magnitude from one to ten acres, are constantly to be seen, beautifying a landscape once so monotonous, and providing shelter for man and beast.

Botany.—In this department of work, carried on until recently by Prof. Bessey, much has been effected in investigating the various species of smut injuring grain, and their effects on stock and horses in causing disease when eaten. The flora of the State has also been thoroughly worked up.

Entomology.—Prof. Osborn, who has this branch in charge, has been very assiduous in working out the life history and habits of the many species of external parasites which affect

cattle. He has also specially studied the Phytoptidæ, a group of insects the individuals of which are so small as scarcely to be visible to the naked eye, which, nevertheless, inflict serious injury on our forest and fruit trees and other vegetable products. Much attention has also been given here to the bark lice, to galls and blister-mites, and many experiments tried with insecticides.

Veterinary Department.—A very complete veterinary building has been recently erected and a school of instruction in this branch established, under Prof. Stalker, who graduated a few years ago at the Veterinary College in Toronto, Ontario.

Revenue and Expenditure.—The total revenue of this institution is about \$48,000, which is sufficient to meet the present outlay. The cost of the teaching staff is \$28,000 per annum, the professors receiving from \$1,600 to \$2,100 each—the President \$3,100.

The sum spent on the experimental farm and horticultural department in excess of revenue, and apart from the salaries of professors, averaged for the years 1882 and 1883—the latest reports obtainable—\$4,812 per annum.

KANSAS.

The State Agricultural College of Kansas is situated about a mile and a-half from the town of Manhattan, 118 miles from Kansas City, on the line of the Union Pacific Railway and near the centre of the State. The land occupied by the institution is 364 acres, 105 of which was recently purchased, at \$125 per acre. It is all well situated, being high-rolling prairie, every portion of which is available for farm purposes without draining or other special preparation. The endowment fund amounts to nearly \$500,000, and the value of the land, buildings and equipment, is \$161,500. The buildings, which are all of Manhattan limestone, are judiciously placed on the highest parts of the ground, and command a fine view of the farm, the adjacent town and the surrounding country.

The college, while known as a college of agriculture, necessarily covers in its teaching a much wider field than its name

would indicate. The facilities available to farmers' sons in the rural districts for obtaining a liberal preliminary education are not as good in this newly settled country as in the older States, hence a considerable part of the work of this college is in the line of preliminary training, a portion of which, in older communities, would have been acquired by the students before entering. The pupils at present number 360, one-third of whom are females. Beginning with the ordinary branches of an English education, the student is gradually introduced to the higher departments of learning, associated with a training in practical chemistry, agriculture, horticulture, botany, entomology and general zoology. In the industrial departments the young men are instructed in practical agriculture, horticulture and dairying, also in mechanical work, both in wood and iron. The young women receive instructions in dairying and in household economy, including cooking and kitchen work, as well as in sewing, printing, telegraphy and music.

Prof. Fairchild, the President of the college, is a gentleman of high attainments, who commands the respect and esteem of both staff and pupils. There are no dormitories in this institution and no provision for boarding the students, who seek board and lodging in the adjoining town, an arrangement which permits of the college being entirely laid out with a view to teaching purposes. The main building, 130 x 250, is provided with class rooms, well equipped with apparatus, also a library of 4,000 volumes, reading room, sewing rooms, dairy, kitchen, etc.

The chemical laboratory is a separate building, with ample accommodations for training 80 students at one time in practical work. Mechanics hall is a large two story building, with carpenter's shop, printing office, telegraph office, etc. Horticultural hall contains class rooms, museum and work rooms, with a large conservatory and propagating house attached. The outbuildings are of a substantial character, and very well arranged, especially the buildings for housing stock and for carrying on experiments in feeding animals.

Stock.—The college herd consists mainly of thoroughbreds, embracing four distinct breeds, viz., Durhams, Jerseys, Polled Angus and Galloways. The surplus stock produced by these animals is sold to the public from time to time as it accumulates. No service is rendered by the male animals, other than exchange service with private breeders of thoroughbred stock, of which there are some fifteen in all within a few miles of the college. Some experiments have been made in producing grade cattle for market, but the stock is maintained chiefly for the purposes of illustration and instruction. This institution is also in possession of four breeds of swine, viz., Berkshire, Essex, Poland-China and Jersey Red. The Berkshires are preferred, for the reason that they are less liable to disease in that climate, while they are found to attain maturity quite as rapidly as those of any other breed. The pigs also are kept solely for the purposes of instruction and experiment. Nothing has yet been done here in other departments of stock raising.

Field Experiments.—The experimental work carried on for the past three years has included the testing of a number of varieties of corn, with different methods of treatment, also of sixty-five sorts of wheat; in the cultivation of mangolds, and in growing grasses and clover. Tests have also been made as to the relative value of manures. The grass and clover experiments have been of great value, and have demonstrated the practicability of growing red clover and orchard grass for fodder, which had formerly been held to be impossible in that climate.

Horticulture.—In the horticultural department many new varieties of fruit and ornamental trees, shrubs and vines, are being tested as to their adaptability to this trying climate, and new varieties are yearly added to the list as they become available. The orchards contain about 275 varieties of apples, 80 of pears, 16 of plums, 20 of cherries, 10 of apricots and 50 of peaches. In addition to these, about 200 varieties of small fruits are being tested, and in the vineyard about 100 varieties of grapes.

The climate of Kansas is very trying to fruit trees and vines. But few of the better varieties of apples succeed, while the trees suffer much from blight. Pears also are so very subject to blight that their cultivation has been almost abandoned. Plums are much injured by the curculio. The Cuthbert raspberry is not hardy, although Turner and Shaffer's Colossal stand well. The Manchester and many other varieties of strawberries fail, from the foliage burning up in the hot, dry summer. The Crescent and Chas. Downing are the two varieties reported to succeed best.

Forestry.—Experiments are being conducted in forest planting for shelter, which is much needed in this State, on account of the high winds which prevail almost continually. A twelve acre plot has been devoted to tree-planting, where twenty species of forest trees are being cultivated. As yet, tree-planting has been carried on but to a limited extent; small clumps only are seen at rare intervals. There is very little native wood, excepting that which lines the margins of streams and rivers.

Botany.—A conservatory and propagating house has been built, at a cost of about \$3,000, which furnishes the necessary material for botanical lectures, and also bedding plants for outside decoration. A portion of the expense of running this department is defrayed by the sale of surplus stock.

Revenue and Expenditure.—The annual revenue is about \$35,000, which meets all the expenses of instruction, and with occasional appropriations from the State for buildings, supplies the means for carrying on the work. The teaching staff receive \$21,550, the salaries of professors ranging from \$1,400 to \$2,500. Student labour is employed to a considerable extent in all the departments related to agriculture, but is only paid for when given in addition to the hours required by the college regulations, and upon work solely for the profit of the college. The yearly expenditure on this account amounts in all to about \$3,500.

Conclusion.—The results of the experimental and other work in all the departments are given to the public promptly,

in a neatly printed four page sheet, known as "The Industrialist," which is published weekly by the printing department of the college.

KENTUCKY.

The Agricultural and Mechanical College of Kentucky is located at Lexington, on 52 acres of land within the city limits, which was given by the city for college purposes. The land is valued at \$25,000, the buildings at \$85,000, making a total of \$110,000. The endowment fund amounts to \$165,000.

The aim of this college is to teach those branches of learning which are related to agriculture and the mechanic arts. The education provided is of a very general character. There is no special department of agriculture, although efforts are being made to organize one. Instruction is given in agricultural chemistry; lectures on the relations of geology to soils, the influence of forests on agriculture, also on insects which are injurious to crops. The number of students attending, according to the last returns, was 320.

Revenue and Expenditure.—The annual income from the endowment fund is \$9,900; proceeds of a special tax of $\frac{1}{2}$ cent on each \$100 of taxable property within the State, \$16,000; tuition fees, \$2,500—total, \$28,400; which is sufficient to cover the expenditure, a large proportion of which is required to pay the teaching staff.

LOUISIANA.

The State University and Agricultural and Mechanical College is situated at Baton Rouge, and is the result of a combination of the old State University, formerly at Alexandria, with the agricultural and mechanical college. The combined endowment funds amount to \$318,000, and the land, buildings and appliances are valued at \$350,000.

The aim of this institution is to provide general instruction and education in all the departments of literature, science and art, and includes special instruction in agriculture and the mechanic arts. The education in agriculture includes a train-

ing in the cultivation of sugar, cotton and rice, and in general farm work. Instruction is also given in farm architecture, surveying roads, levees, ditches, etc.; also in veterinary surgery. One hour a day is devoted to labour in the field, garden or workshop. According to the latest published returns, the number of students attending is 159.

Vaccine Establishment.—A station for the production of vaccine lymph has been established, the work of which is carried on chiefly by the students, under the direction of the professor in charge. It is said that the vaccine department has been self-sustaining, besides gratuitously distributing a large number of points every year, and has received the hearty approval of the physicians of the State.

Revenue and Expenditure.—The annual income derived from the endowment fund is \$14,500, to which must be added an annual State appropriation of about \$10,000, making \$24,500 in all. This is sufficient to meet the current expenses, the largest item of which is the salaries of the teaching staff.

MAINE.

The State College of Agriculture and the Mechanic Arts is located about a mile from the town of Orono, and within nine miles of Bangor. The land occupied by the institution is 376 acres, the greater part of which is under cultivation. The soil consists principally of clay loam, with a part of stiffer clay. The college was established in 1868. The land, when purchased, comprised two farms, which were much run down, and the price paid for the land, with the farm buildings, was \$11,000. This was presented to the college by the neighbouring towns, Orono and Oldtown. About \$130,000 have since been spent in the erection of buildings and other permanent improvements.

The endowment fund derived from land grants is \$132,500, the interest of which amounts to nearly \$8,000. In addition to this the college receives direct subsidies from the State. For the past two years only \$7,000 a year has been voted, and the amount has varied from this sum upwards to \$25,000 a

year, the larger amounts being given when additional buildings were being erected.

This institution aims to give the young men of the State, at moderate cost, the advantages of a liberal and practical education, paying particular attention to such branches of learning as are related to agricultural and mechanic arts.

Stock.—The college herd consists of 42 pure bred animals, 32 Jerseys and 10 Shorthorns, and 6 high-bred grades, crosses between Jerseys and Ayrshires. The use of the male animals is extended to neighbouring farmers, as far as circumstances will permit, at the nominal charge of \$1. The herd has not yet increased to the number it is desired to retain on the farm, for which reason there have been no sales, except of surplus male animals, which have been sold to farmers in the State for improving their stock, at from two to eight months old, at prices varying from \$25 to \$75 each. The stock is used partly for illustrative purposes in teaching, is also utilized to some extent for breeding experiments, but mainly for dairy purposes. A large quantity of butter is annually produced, which is sold, and the proceeds applied towards the expenses of the farm. About twenty acres of land only are reserved for pasture, which, during the summer season, supplies about one-third of the food required for the stock, and serves to give them exercise and air; otherwise they are fed the entire year on dry fodder and grain.

From 80 to 100 pigs are raised each year, all of the Chester White breed, nearly all of which are sold to farmers in the State for breeding purposes.

The stock also includes from 20 to 30 pure bred Shropshire sheep, and both young and mature animals are sold to farmers in different parts of the State for breeding. Shropshires are preferred here to Southdowns, on account of their larger size and heavier fleece, and they are held to be equally good breeders and to produce mutton of as good a quality as the Southdowns.

No horses are bred but such as are required for use on the farm.

The influence of the college work in the improvement of stock has been very marked, and has been felt throughout the entire State. The improvement has been so great that some are of opinion that stock generally has doubled in value since the college began this department of work. As there is not so much private enterprise in stock raising in Maine as in many other States, the influence which the college has exerted in this direction has been relatively greater than in many other districts where similar institutions exist.

Field Experiments.—A number of varieties of wheat, barley and oats have been tested in experimental plots, the best of which, after several years trial, have been grown on a large scale in field culture for the purpose of obtaining seed in large quantities, so that it might be supplied to farmers at moderate prices, with a view to the general introduction of such desirable sorts throughout the State. The Gold Medal winter wheat, originally produced by hybridizing by the late Charles Arnold, of Paris, Ont., is highly esteemed here, and is regarded as one of the best sorts in cultivation. It has been thoroughly tested on the college farm and very generally disseminated, and it is claimed that this variety produces larger and more certain crops than any other wheat grown in Maine.

No spring wheat is grown here; its cultivation was abandoned some years ago, owing to the crop having been almost destroyed for several years by the weevil.

Among barleys the Manchurey is held to be one of the best. It is a large six-rowed variety, with a light coloured grain, a regular and heavy bearer, and is much appreciated. The Purple Hull-less is another sort much praised. The seed of this was first disseminated by the United States Department of Agriculture. It has a dark coloured grain without husk or hull, is broad leaved, vigorous, and stools freely, and is said to yield from 35 to 50 bushels per acre, and weighs from 62 to 64 pounds to the bushel.

In oats the Hogan, a variety introduced from Ireland, is highly esteemed. This is a white oat, yielding from 50 to 90 bushels per acre, and weighing about 40 pounds to the bushel.

All these have been widely disseminated throughout the State from the college farm, and are now said to be the leading sorts in cultivation.

The only roots which have been tested to any extent are potatoes, and of these the Beauty of Hebron stands highest in productiveness and quality. There has not been much done experimentally in fodders beyond tests with Alsike clover, Millet and Hungarian grass. Hay is a very important crop, and is largely grown. The size of the experimental plots is 1 x 4 rods, and the tests are usually made in duplicate, the results from each plot being given. The whole farm is systematically worked, a careful record being kept of each crop.

Horticulture.—Very little has been done in this department beyond the planting of ornamental trees singly and in clumps for shelter and ornament.

Entomology.—This branch is carefully taught, and the teaching aided by collections of preserved specimens of injurious insects from the college museum. Many of the more important species are also bred in the class room, so as to give the students the opportunity of becoming familiar with them in all their different stages. The professor who has charge of this branch, together with botany and zoology, Professor C. H. Fernald, brings high qualifications to bear on the work. He is well known throughout the scientific world for his thorough and original work, and has published some very valuable reports, including one on the grasses of Maine, which is beautifully illustrated, and one on the butterflies of the State.

Experimental Station.—The experimental station, which has a separate allowance of \$5,000 a year from the State, was organized in the spring of 1885, and has thus far been mainly a chemical station for the analyses of commercial fertilizers and cattle foods. Wood ashes are extensively used in this State as a fertilizer, both leached and unleached, and much of the time of the officers of the station has of late been given to determining the relative manurial value of ashes from different sorts of wood.

Some useful experiments have been made in feeding, particularly with sheep, to ascertain the relative value of corn-meal and hay as flesh producing material. In this connection digestion experiments have also been carried on to determine the quantity digested and assimilated in each case as well as the proportion rejected in the excreta, together with the manurial value of the excreted products.

Some attention has also been given to the examination of agricultural seeds, for the purpose of ascertaining their purity and quality, and to investigations connected with insect pests. The station invites the farmers of the State to co-operate and correspond. The Director desires to make it a bureau of information, which agriculturists may freely consult.

The outdoor work thus far has consisted in growing corn for fodder, and in endeavouring to determine the value of ensilage.

Revenue and Expenditure.—The interest from the endowment fund brings the college about \$8,000 a year, to which must be added \$7,000 from the State and about \$2,000 from tuition fees—\$17,000 in all. Of this sum \$12,660 is paid in salaries to the faculty, the remainder covering other expenses. The salary of a full professor is from \$1,500 to \$2,000, with, in some instances, a house. The farm superintendent, who manages the whole of the farm operations, receives \$1,000 a year, his house and entire living, also the use of a horse. The last report shows the farm expenditure to have been \$1,347 in excess of the revenue, but a considerable quantity of experimental work was done, which is always expensive.

MARYLAND.

The Maryland Agricultural College is located at College station. The land occupied comprises 286 acres, with artificially drained meadows and dry bottom and rolling uplands. The endowment fund is \$112,500; the value of land, buildings and appliances, \$100,000. The main building is an imposing structure, 120 feet long, 54 feet wide and six stories high, and is well arranged for the purpose. While the education, as in

most of the other colleges, is largely of a general character, it is claimed that a considerable proportion of the students are taking the special agricultural course. The average number of students attending is about 75.

A herd of stock is kept for use and breeding. Ten acres of land are devoted to vegetables, and several acres to fruits and flowers; a number of plots are also being used for the testing of cereals.

Revenue and Expenditure.—The receipts include interest from endowment fund, about \$7,000; annual State grant, \$6,000; board and tuition fees of students, about \$12,000; total, \$25,000. The expense for salaries of the teaching staff is \$8,000. The balance is required to meet the other current expenses.

MASSACHUSETTS.

The Massachusetts Agricultural College and Experiment Station is situated within about a mile of Amherst. It was established in 1867, and occupies 382 acres of land. The endowment fund, from sales of public lands, is \$246,314, which has been increased by the State to \$360,067. The value of land, buildings and appliances is \$205,771.

This is one of the oldest of the agricultural colleges, and has accomplished much good work, both in the teaching and experimental lines. In 1870 the late Prof. L. Agassiz, acting as chairman of the examining committee, reported that "the theory of scientific agriculture is thoroughly taught, and the application of such knowledge is made on the farm. All students are compelled to work at the details of husbandry, so that manual labour becomes a valuable adjunct to mental application."

Stock.—The college herd numbers from 50 to 60 cows, including from 15 to 20 pure Ayrshires. The chief aim has been to produce milk, the cream from which is collected and made into butter, and the skim milk sold either to the experimental station or to the neighbouring farmers to be fed to the pigs. In this connection trials have been made with

different kinds of fodder plants, to ascertain how far they affected the quantity and quality of the milk and butter. Experiments have also been made to test the comparative value of methods of setting and treating milk in the dairy; the productiveness of different breeds of cows, and accurate investigations as to the comparative nutritive and feeding value of northern, southern and western varieties of Indian corn.

Field Experiments.—Among the more important experiments with field crops which have been conducted here are the following: The growing of sugar beets, the manufacture of sugar from them, and trials of their value as food for cattle; the growing of early amber cane and the manufacturing of sugar from its juice; trials with South Carolina mineral phosphates in the raw state, and after treatment with acids, to determine their agricultural value, and similar experiments with salt, and with simple and compound commercial fertilizers.

Horticulture.—The orchard for large fruits covers from eight to nine acres, and contains a number of varieties of apples, pears, plums and peaches. Peaches do not always prove hardy. During the past fifteen years the college has had about five crops of this fruit. Of small fruits there are many varieties, including most of those generally grown, and many of those of recent introduction.

The horticultural department occupies 45 acres, including fruits, vegetables, ornamental and forest trees. A large number of vegetables are grown and different sorts tested. Three acres are devoted to a nursery, where students are taught the arts of budding and grafting. Among the experiments with forest trees there are examples of three-fourths of an acre each of European larch and Scotch pine. These were planted on a poor piece of land, which was of no value for ordinary crops. The trees were three feet high when transplanted from the nursery, have been nine years out, and will now average from 25 to 30 feet in height and five to six inches in diameter.

Greenhouses.—There is an extensive conservatory and a propagating house, 100 x 17, the total cost of which has been \$12,000. These are filled with choice plants, and are utilized in growing a large number of plants and flowers for sale, the receipts from which defray the greater part of the working expenses of this department. All products, both of farm and garden, are sold, and the proceeds applied to current expenditure. The farm is said to be almost self-sustaining. In the botanical department there is a herbarium consisting of 10,000 plants.

Revenue and Expenditure.—The revenue from the endowment fund is \$13,000, which, by tuition fees and income from other sources, is increased to about \$25,000. Nearly \$12,000 of this is paid in salaries to the teaching staff, the remainder used in defraying other expenses. The salary of a full professor is \$2,250; assistants receive from \$800 to \$1,200, and should their services be continued, are gradually raised to the full salary.

Experimental Station.—The experimental station, although occupying 10 acres of the college farm, is an entirely separate institution. It was begun in 1883, when Prof. Goessmann was appointed Director, a gentleman of high scientific attainments, and eminently fitted for the position. It is supported by a special grant from the State, which at first was \$5,000 annually, but which has since been increased to \$10,000. Five or six acres of land have been set apart for growing crops, such as fodders and grasses.

Many interesting tests have been made with leguminous plants, such as white lupine, vetch, lucerne, southern cow-pea, horse-bean, etc. The southern cow-pea is highly esteemed for several reasons. It completely smothered out all weeds, and makes a most valuable fodder crop green for cows, they being very fond of it. It is also useful as a green manure. The varieties grown here have not matured any seed, for the reason that the season is not long enough; but some earlier ripening sorts are expected from the South, which it is hoped will perfect their seed in this locality. This objection, how-

ever, does not materially affect the value of the cow-pea as a fodder crop, since seed can be procured very cheaply from the South.

The horse-bean produces a growth of from 3 to 4 feet in height, is of a very succulent character, and decays rapidly when buried. On this account it is held to be one of the most useful of the leguminous plants for green manuring. Tests have also been made with many other forage crops, with ensilage, and with a number of varieties of Indian corn. Experiments have also been conducted to determine to what extent the vitality of seeds is affected by age, and observations made on the vitality of the seeds of various weeds.

Feeding experiments with cows and pigs have been carried on for several years, and some valuable reports published.

One of the principal features in this station is the chemical department, which has been conducted with great success, although lacking a suitable building for the work. A new and very commodious laboratory is now nearly completed, which will be fitted with all needed apparatus and modern appliances, which will doubtless lead to still greater efficiency. The results of a large number of analyses have been published, including commercial fertilizers, fruits, field crops, weeds, fodders, fish waste, ensilage, etc.

Much credit is due to the energetic Director for the efficient manner in which the work of this station is done.

MICHIGAN.

The Michigan State Agricultural College was begun in 1857. It is the oldest institution of its class in the United States, and probably the most distinctly agricultural in its character. It is located three miles from Lansing, the capital, and occupies 675 acres of land. The soil is variable, a portion being sandy loam and a portion clay loam. The land is valued at \$75 an acre, and the land, buildings and appliances at \$338,471. The endowment fund is \$339,000, with a large quantity of agricultural lands still unsold. The buildings are very extensive and complete.

The full course of study occupies four years, and embraces the elements of a general education, the study of agriculture in all its departments, and of the sciences on which agriculture depends. For the past three years the attendance has averaged 180, and it is said that about one-fourth of the whole number graduate. Tuition is free, alike to all within and without the State. Each student is required to do two hours' work each day, for which he is paid, the remuneration varying from 8 to 12½ cents per hour, depending partly on the nature of the work, and partly on the industry of the student. The work is chiefly hand labour; they are seldom employed in field operations.

Stock.—The college herd numbers from 80 to 100, and the animals are mostly pure bred. The Shorthorns predominate, besides which there are Herefords, Jerseys, Polled Angus, Galloways, Ayrshires and Holsteins. These breeds are kept mainly for the purposes of illustration in teaching and for experiments in feeding. From 100 to 150 sheep are kept, chiefly Merinos, Shropshires and Southdowns; also a number of pigs.

Field Experiments.—On the farm a regular system of rotation of crops is maintained. Experiments in the cultivation of grain are carried on to some extent, but it is difficult to accomplish much in this direction when so large a proportion of the time has necessarily to be devoted to teaching.

Horticulture.—About 80 acres are devoted to ornamental grounds, the trees and shrubs being utilized as object lessons. There is an orchard of apple trees covering about 10 acres, and on another part of the ground one of pear trees, containing about 150 trees; there are also 50 plum trees. The very cold winters of late years have killed some of these; hence there are a number of vacancies in the orchards. Peaches are not much grown, as they do not succeed well in this part of Michigan. The vinery contains about 100 sorts of grapes, and many tests have been made with strawberries, raspberries and small fruits.

Greenhouse.—A very handsome conservatory, with propagating houses attached, has been built, at a cost of \$9,500, in which are stored a number of plants useful for teaching and ornamental purposes. Some sales are made of plants and flowers, the proceeds of which are applied to the payment of current expenses.

Botanic Garden.—A small botanic garden has been established, which is being gradually extended. The botanical department, which is in charge of Prof. Beal, is most efficiently conducted and is very popular. It is carried on in a separate building, in which there is stored an excellent museum of vegetable products.

Apiary.—An apiary of considerable dimensions has been established under the direction of Prof. A. J. Cook, who is quite an enthusiast in this department. He is in charge of the department of zoology, and gives the students instruction in entomology, paying particular attention to injurious insects.

Revenue and Expenditure.—The annual revenue from the endowment fund is \$23,734, which is liberally supplemented by State appropriations as needed. The annual expenses are about \$29,000, of which the salaries of the teaching staff absorb \$21,000. The salaries of the professors range from \$1,800 to \$2,000.

MINNESOTA.

The endowment fund provided for sustaining a college of agriculture and mechanic arts in this State has been given to the university on condition that it maintains efficient agricultural and mechanical departments. This institution is located at Minneapolis, about one mile below the Falls of St. Anthony, on an elevated bluff overlooking the city and falls. The productive funds of the university are \$575,000; the value of land, buildings and appliances, \$220,000.

By the extension of the city, and the building of a railway through the grounds, the college land has been so cut up as to be no longer fit for agricultural use. A new experimental farm of 155 acres has lately been purchased, which will be

devoted to testing various cereals, fruits, vegetables, etc., for the purpose of determining those best adapted to endure the trying climate of this northern situation.

In the agricultural college a full course of instruction is given, embracing both theoretical and practical agriculture. The students have the full benefit of the library and apparatus of the university. There is also a museum of agriculture, and a greenhouse 45 x 34, which supplies plants and flowers for botanical teaching.

Revenue and Expenditure.—The income from productive funds is about \$35,000; from State appropriations, \$23,000—total, \$58,000. There being about 500 students in all in attendance, a large faculty is required, and a large proportion of the revenue is expended in salaries.

MISSISSIPPI.

The fund resulting from the sales of public lands granted for the education of the people of Mississippi in agriculture and mechanics has been divided equally between the white and coloured races. Reference will first be made to the institution for the whites, which is known as the Agricultural and Mechanical College of Mississippi, and is situated about a mile and a half from Starkville. It occupies 1,750 acres of land, about 600 of which is under cultivation. About 400 acres are good land; the remainder is known as gullied and hill land, and leaving out of consideration 200 acres of woods, consists chiefly of worn out cotton fields. These worn out lands are, by liberal treatment, being gradually restored to their normal condition of fertility, and are being converted into fields of corn, grain, grasses, etc.

The endowment fund is \$113,575; the land, buildings and appliances, are estimated at \$203,400.

The leading object of this college is declared to be to benefit agriculture and the mechanic arts. Its efforts are, however, like most similar institutions, chiefly directed towards general education, with a special class or division in agriculture.

In the stock department the college has pure bred Jerseys, Holsteins, Galloways and Shorthorns, Merino sheep and Berkshire swine, all of which are used to illustrate the lectures on stock given at the college.

A special dairy department has been established, so constructed as to secure, as far as possible, an even temperature throughout summer and winter; the milk obtained from the college herd, numbering about 200 in all, being used for the manufacture of butter. The college creamery also draws supplies of cream from the neighbouring farmers, by which the butter product is materially increased.

The field experiments include the testing of the value of different fertilizers on crops of cotton, corn, sugar cane, sorghum, wheat and other cereals, grasses and forage crops; reports on the value of ensilage in stock feeding, also the comparative results of feeding with cotton-seed meal and other nutritive substances. The farm has been worked so as to return, in revenue and in increase of stock, more than an equivalent for the money spent on it.

One hundred acres are devoted to horticulture, including nine acres of small fruits, an orchard of over 5,000 trees, including 1,250 apple, 500 pear, 300 plum, 2,000 peach, 375 mulberry, 20 Japanese persimmon and 30 apricot, a vineyard with a large assortment of grapes, a nursery and a twenty-acre field devoted to vegetables. New varieties of fruits, both large and small, as well as vegetables, are constantly being planted to test their merits. All students are required to devote three hours each day for five days in the week to work on the farm or in the garden or workshop.

Revenue and Expenditure.—From interest on endowment fund \$5,678, which is supplemented by State appropriations.

Alcorn Agricultural and Mechanical College.—This college is specially designed for coloured people, and is located near Rodney, a short distance below Vicksburg. The endowment fund is \$113,575, the estimated value of land, buildings and appliances, \$43,000. The revenue from the endowment fund is nearly \$6,000, the expenses about the same.

In the college proper there are fifteen students, with a faculty of three professors. The preparatory school connected with it has 170 scholars and five instructors; tuition is free.

MISSOURI.

The Agricultural and Mechanical College of Missouri has been organized as a department of the University of the State, which is located at Columbia, on the Missouri River. The endowment fund is \$219,000, value of buildings, land and appliances, \$150,000. The college farm consists of 640 acres, has a variety of soils, and is well watered. It affords opportunities for student labour, practical work and agricultural experiment. Gardens, orchards and vineyards have been planted, and are being closely observed and records taken.

A large amount of experimental work has been done, bearing directly on the agriculture of the State, including experiments with many varieties of corn, with 47 sorts of wheat and with other cereals; tests of many varieties of grasses and other forage plants have been made, the methods of using potatoes for seed have been investigated, and the trials repeated every season for four years, during which time some very practical conclusions have been reached. Many experiments in feeding have been conducted, including the fattening of steers, feeding for the production of milk, feeding pigs, with the special purpose of producing lean meat; also with grass-fed pigs. In cultivating the soil, the effects of subsoiling have been carefully observed, and tests made to determine the relation of dew to soil moisture.

A nursery has been established and a plantation of forest trees commenced. The latest reports give the attendance of students in the special agricultural course as 21.

The interest from the endowment fund is about \$11,000, which is supplemented by State appropriations.

NEBRASKA.

The Agricultural College of Nebraska is a branch of the University of that State, and is situated at Lincoln. The

college farm consists of 320 acres of land, all improved, with good buildings, five breeds of cattle and two of pigs. Orchards have been established, some forest planting has been done, and an arboretum commenced. About 15 students are in attendance on the special agricultural course. The institution is sustained by annual appropriations from the State, as most of the agricultural lands appropriated for this purpose are yet unsold.

NEVADA.

In this State \$90,000 have been received from the sale of agricultural lands, which has been invested. The college has not yet been organized. In the meantime, the fund is being yearly increased by the interest added to it. It is proposed that it be located at Elko, in connection with the State University.

NEW HAMPSHIRE.

The New Hampshire College of Agriculture and Mechanic Arts is an institution associated with Dartmouth College, Hanover. The endowment fund from land grants is \$100,000, and the value of lands, buildings and appliances, is \$100,000.

The college farm consists of 360 acres of land, with a soil admirably suited for agricultural experiments. The stock includes a herd of 50 cattle, consisting of pure Durhams and Ayrshires, together with their grades; also 40 Cotswold sheep and some horses. Experiments with field crops are being constantly carried on in a portion of the farm devoted to that purpose. Feeding tests have also been made to determine the relative value of roots, cornmeal and bran, and early and late cut hay; also with different fertilizers, to ascertain their relative value.

The revenue derived from the endowment fund is \$6,000; from annual State appropriations, \$3,000—total, \$9,000; which is sufficient to meet current expenditure. The number of students taking the agricultural course is small.

NEW JERSEY.

In the State of New Jersey, Rutgers' Scientific School at New Brunswick, which is a very old institution, established

AGRICULTURAL COLLEGES.

before the Revolutionary War, acquired possession of the agricultural land grant, and thus became the State College of Agriculture and Mechanic Arts. The 210,000 acres received were sold for \$116,000. This produces \$6,960 a year, which is devoted to the payment of salaries; \$30,000 has been spent on a farm of 98 acres, \$50,000 on buildings, and \$13,000 for equipment. The land on which the college buildings are placed consists of seven acres within the limits of the town. The farm is about two miles distant from the college. It is managed by a farm superintendent, and has no appropriation and no resources other than moneys realized from sales of produce. The soil is a loam of mixed sand and clay, well drained and all improved.

There is a herd of about 60 cows of all sorts—no first-class specimens among them—which are kept solely for milking purposes. The milk is sold in Jersey City or New York to the wholesale dealers, and is shipped in cans daily. A continuous record is kept of the total product of milk. A few pigs are also kept, but none of them are pure bred.

The farm when bought was in very poor condition, but has been thoroughly drained and enriched by fertilizers, so that land which at first would not yield 10 bushels of wheat to the acre, will now yield about 30 bushels.

Under the able direction of Prof. Cook, who is Professor of Agriculture in the college and Director of the experimental station, much useful experimental work has been carried on for many years. In field experiments many varieties of winter wheat and rye have been tested. These are grown at first in plots of one-tenth of an acre each, treated with different sorts of fertilizers, and the more promising sorts afterwards grown on a larger scale. Fultz wheat is esteemed here as among the best of the winter wheats. It is a small-grained amber wheat, with a short, stiff straw, and will yield from 20 to 40 bushels per acre, or an estimated average in general culture of 25 bushels. The experiments in cereals have been repeated year after year for a number of years. Sorghum has been grown on a large scale, and a satisfactory yield of sugar obtained.

The cultivated land of New Jersey had long been cropped under the old system of taking everything possible out of the soil and returning little or nothing to it, and hence in many districts had become so much exhausted that it would no longer produce paying crops. Now, and partly from the stimulus given by the publication of the results of the experimental work of the station, manuring and enriching have become general, the science of supplying the soil with such elements as may be specially required has been carefully studied and practised, and the result is that many farms which a few years ago were scarcely considered worth working, are now once more yielding good crops; the State is, in fact, becoming in this respect rejuvenated. Besides the growing of corn, winter wheat and rye, which are the principal grain crops, grapes are largely cultivated, and the growing of peaches, which in many districts had been practically abandoned, is being resumed. New orchards are being planted on a large scale, and there is every reason to expect that within a short time New Jersey will regain her former position as a peach-growing State, and under the new system of agriculture so generally adopted, retain that position.

The needs of the State have been such that the efforts of the experimental station have been chiefly devoted to determining the value of fertilizers by chemical analyses, and publishing the results obtained for the guidance of farmers in bulletins, which are issued several times during the summer, and sent to every farmer in the State who expresses a desire to have them. A special appropriation of \$8,000 a year is made by the State to defray the expenses of the experimental station.

NEW YORK.

The New York State College of Agriculture and Mechanic Arts is associated with Cornell University, at Ithaca, founded by the liberality of Ezra Cornell. The endowment fund obtained from the sale of agricultural lands is \$473,412, with large tracts of land still unsold. The total income of the

university from all sources is about \$130,000; the expenditure, including \$85,000 for salaries, is about \$120,000.

A special course in agriculture is provided, under an able staff of professors. The course of instruction covers the whole field of scientific and practical agriculture and horticulture. Students are required to spend three hours a day for two days in each week in farm work, and in the handling and feeding of domestic animals. In horticulture they have the advantage of experimental work in the garden and conservatories. Economic entomology is also taught by lectures and by practical work in the field.

The university farm consists of 120 acres of arable land, the larger part of which is used for experimental purposes. The stock kept is used also for similar ends. Statistics of both experimental work and management of stock are kept on such a system as to show, at the close of each year, the profit or loss, not only of the whole farm, but of each crop and group of animals.

While nearly 400 students attend this university, and so many advantages are offered to those desiring to study agriculture, the agricultural class seldom exceeds in number from 20 to 25.

Experimental Station.—This institution has no endowment fund from agricultural lands, but is entirely supported by annual State grants. It was incorporated by an Act of the State Legislature passed during the Session of 1881, and during that year a farm of 125 acres was purchased for \$25,000. This expenditure was met by special appropriation, and a further sum of \$20,000 a year provided by the State for carrying on the work.

The farm is situated nearly two miles from the town of Geneva, and occupies an elevated position, the land undulating, with a gradual slope towards the south. The soil is a heavy clay loam, more or less gravelly. The buildings on the farm at the time of purchase were a large residence, stables and outbuildings. The lower story of the dwelling has been fitted up for the experimental work of the station, one side as

a chemical laboratory, the other as agricultural and horticultural offices and museum. The Director, Dr. Sturteyvant, occupies the upper floor as a dwelling. A considerable sum has been spent in repairing the buildings and in altering them to meet the requirements of the case, and still they are very unsuitable for the purposes they have to serve. The new building is now in process of erection for dairy work.

Stock.—The stock consists of five thoroughbred Jersey cows, which are kept solely for experiments in milk and butter.

Field Experiments.—More than 100 varieties of wheat have been tested, and their relative merits discussed in the bulletins and reports which have been issued by the station. The Wayne County Select has proved to be a very excellent wheat here, a good cropper, and an early variety, which stools well. Surprise is another productive sort, highly prized, in which the spikelets usually have four grains of seed in each. Martin's Amber, Landreth and Silver Chaff, are also regarded as very promising varieties. Oats and barley have also been similarly tested. With many sorts of vegetables and roots, especially potatoes, the trials have been numerous, and the results of great practical value.

Field Experiments.—More than 100 varieties of wheat have been tested, and their relative merits discussed in the bulletins and reports which have been issued by the station. The Wayne County Select has proved to be a very excellent wheat here, a good cropper, and an early variety, which stools well. Surprise is another productive sort, highly prized, in which the spikelets usually have four grains of seed in each. Martin's Amber, Landreth and Silver Chaff are also regarded as very promising varieties. Oats and barley have also been similarly tested. With many sorts of vegetables and roots, especially potatoes, the trials have been numerous, and the results of great practical value.

Horticulture.—The orchard was planted in 1884, and contains 81 varieties of apples, 26 pears, 45 peaches, 33 plums, 30 cherries, 6 quince, 16 nectarines and 20 apricots. In small fruits the institution has 42 sorts of grapes, 40 strawberries,

50 raspberries, 10 blackberries, 23 currants and 7 of gooseberries. A careful account is being kept of them all, and their relative merits recorded.

Greenhouse.—About \$1,200 have been spent on this structure, which is found to be an indispensable requisite for propagating purposes and experimental work during the winter and early spring months. Plants for summer decoration of the grounds are also grown here. A very ingenious apparatus has been devised for testing the germinating power of seeds, by which a large number of tests may be carried on in a small space, and the results conveniently watched.

Chemical Laboratory.—This department is well supplied with apparatus, especially such as is required in the analysis of fertilizers, in the chemical examination of milk, and in determining the purity of water.

Museum.—This is a very interesting and instructive feature, and indicates the character and extent of the work being done. It contains large collections of corn, embracing many varieties, both in the ear and shelled, of wheat, oats, barley, peas, beans and other garden and field crops and vegetables, all of which have been grown at the station; also collections of the seeds of forage plants and weeds.

Staff and Expenditure.—The staff consists of the director, superintendents of agriculture and horticulture, chemist and botanist, the salaries ranging from \$1,000 to \$2,500, with house and the use of such products as are grown on the station. There are also four assistants. A stenographer is employed, to whom the Director dictates answers to correspondence, which are taken in shorthand, written with a type-writer and brought for signature. The stenographer also keeps the books and prepares a type-writer copy of all the bulletins and reports for the printer. The botanist is engaged chiefly in the investigation of plant diseases.

NORTH CAROLINA.

The State University, which is located at Chapel Hill, received the agricultural land grant, and gives instruction in

those branches of learning related to agriculture and the mechanic arts. The endowment fund is \$125,000, the interest of which is \$7,500. This, with State appropriations and other revenue, brings the total income up to \$19,000. The expenses of the teaching staff are \$16,000; current expenses absorb the remainder.

The University has no farm or experimental plots. The teaching is confined to lectures, which cover the whole field of agriculture, including the chemistry of soils, the constituents of plants, nature of plant food, application of fertilizers, etc.

Experimental Station.—This station was established in 1877, was formerly located at Chapel Hill, in connection with the University, but in 1881 it was removed to Raleigh, where it enjoys ample accommodation and possesses all needed appliances in the buildings of the State Agricultural Department. The work of the North Carolina station has been almost exclusively chemical, and mainly in the analysis of fertilizers, soils, minerals and ores. By the information it has given, inferior brands of fertilizers have been driven from the market; the quality of those remaining has been improved and the price reduced. This has resulted in an intelligent demand for fertilizers, which has greatly increased the annual products of the soil. The station has done much to bring into prominent notice the value of the immense deposits of mineral phosphates found in the State, which may now be classed with its most important commercial products.

The station has also made many tests of the purity and germinating power of field and garden seeds, and afforded much protection to the farmers against fraud in this direction.

OHIO.

The State University of Ohio is situated in the suburbs of the City of Columbus, where it occupies 340 acres of land, purchased at a cost of \$300,000; the buildings and equipments have cost about as much more, making the outlay nearly \$600,000 in all. The endowment fund from the sale of agricultural lands amounts to \$538,000. Franklin County, in

which the University is located, gave \$300,000, and citizens of Columbus \$28,000, towards its establishment.

In connection with this University there is not only a department of agriculture but also an experimental station, both institutions doing good work in the direction of practical agriculture. The main work of the University is teaching the higher branches of learning. The total number of students is about 300, of which 35 are taking agriculture, some being entered for a two years course; others for four years. A course of 40 lectures is given each year for farmers, the time occupied with the course being two weeks.

Stock.—The stock consists of a herd of 18 thoroughbred Jersey cattle and a small herd of Devons, besides which there are a number of grades of common cattle crossed with Jerseys. The experiments conducted are altogether in reference to the production of milk, which is regularly sold to the citizens at retail. The net profits last year from this product was \$1,600, to which must be added the sale of calves, amounting to \$246.

A few horses are bred, solely for use on the farm, Percherons being preferred. Nothing is done in sheep. Two breeds of pigs are kept, viz., Berkshire and Poland-China. These are used for illustration in teaching, and for feeding experiments.

Field Experiments.—The field experiments have been chiefly with corn and winter wheat, growing such varieties on a large scale as are found to be most productive in the small testing plots at the experimental station. By this process of selection the wheat fields of the University yielded, last year, 32 bushels to the acre, under ordinary field culture, while the wheat crop, generally, throughout that district, was very poor, owing to long continued cold weather, on bare ground during the winter. Most of the wheat produced on the farm is sold to farmers in the State for seed at \$1.50 per bushel. Experiments are also being carried on with roots and other field crops.

Experimental Station.—Ohio Agricultural Experimental Station is a purely experimental establishment, where all sorts

of grain and other field and garden crops, and fruits, both large and small, are tested, and the results published in bulletins and annual reports. The annual cost of conducting the station is from \$10,000 to \$12,000, \$5,000 of which is a direct annual appropriation by the State; the remainder is furnished by the University. The efficient Director of this station, W. R. Lazenby, is Professor of Horticulture and Botany in the University, and in addition to his class work, supervises what is undertaken by the special staff at the station. This department has been in operation a little more than three years, and is growing in usefulness, and yearly becoming more popular with the farmers and horticulturists of the State.

Experiments with Cereals.—In the experimental plots 118 varieties of wheat have been tested. The sorts most esteemed for cultivation in that district are Velvet Chaff, Silver Chaff, German Amber, Fultz, York White Chaff, Russian No. 2 and Egyptian. Efforts have also been made to improve these promising sorts by cross fertilization and selection. The results of planting the seed at different depths have been noted, thick and thin planting compared; also the effects of winter protection and spring cultivation, and early and late ploughing. Twenty varieties of corn have been similarly tested, and many sorts of barley and oats.

Experiments with Vegetables.—In this department much attention has been paid to the potato. Fifty varieties have been tried, and among the most promising ones are, Burbank, Beauty of Hebron and Rural Blush. Many sorts of sweet corn, beans, peas, cabbage and tomatoes have been tested, and the results given to the public. Six acres are set apart for this special purpose, and in addition to ordinary treatment, the results of early and late seeding, thick and thin seeding, have been tried, and the effects of the use of different sorts of fertilizers on the crops noted.

Horticulture.—Six years ago the university planted six acres with apples and pears, but owing to the unusual severity of the winters of late, about three-fourths of the trees have perished from winter killing, and have been replaced by other

varieties. The number of sorts of apples at present cultivated is 25, and of pears 25. Many of the latter have suffered from blight as well as winter killing. Very few plums are grown, and no peaches. Experience has shown that the fruit trees obtained from nurseries north of Columbus have proved hardier than those grown in that vicinity or further south. Tests are frequently made to show the comparative effects of mulching, cultivation, and of cropping with grass, grain and vegetables among the trees.

In the vineyard there are 60 varieties of grapes, and in the small fruit plantation a large number of strawberries raspberries, currants and gooseberries. Some efforts have been made towards originating new kinds, by cross fertilization, with a measure of success. The products in this department also are sold. The sum realized last year was \$1,278.19, \$900 of which was obtained from sales of small fruits.

Miscellaneous.—Tests have been made with noxious weeds, to determine their relative growth and rapidity of multiplication, and the best methods of extirpating them. Observations on injurious insects have been conducted and recorded, with tests of the several insecticides which have been recommended for destroying them. The vitality of seeds is another line of experimental work undertaken here, and carried out on an extensive scale.

Conservatory.—A conservatory and propagating house has been built, at a cost of \$3,000, which provides the means for carrying on experiments throughout the year. It is attached to the horticultural building, in which there is a museum, lecture room and a convenient office.

Revenue and Expenditure.—The income from the endowment fund is \$32,270. Tuition fees and State appropriations bring the revenue up to about \$52,000. The expenditure is about \$50,000, of which \$27,000 is paid for salaries. The professors receive from \$2,250 to \$2,750 a year.

OREGON.

The proceeds of the national land grant have in this State been given to Corvallis College, located at Corvallis. The

fund amounts to \$50,000. The annual income from all sources is about \$6,000, most of which is spent in salaries.

No experimental work is done here, but practical and scientific agriculture is taught, including stock raising, the construction of farm buildings, drainage, analysis of soils, fertilizers, etc.

PENNSYLVANIA.

The Pennsylvania State College of Agriculture is located in Centre County, about the middle of the State, and nearly ten miles from Bellefonte. The endowment fund belonging to this institution is \$500,000; the estimated value of lands, buildings and appliances, \$451,600. The main building is an imposing structure of magnesian limestone, occupying a commanding position. It is 240 feet long, 80 feet wide, and five stories high.

The college owns three experimental farms—one of nearly 300 acres, on which the buildings are located; one in Chester County, of 100 acres, and one in Indiana County, of 100 acres. The soil of the farm at Centre County is a clay loam, mixed with limestone, with some flint, and seems to be well adapted to the growth of the grains and grasses cultivated in this district. Very little purely experimental work is carried on in the outlying farms, as they are not easily accessible to the students. These are cultivated with hired help, with the usual rotation of crops.

The course of instruction in agriculture is of a very practical nature, and combines farm work with teaching.

Stock.—About 20 animals compose the college herd—6 thoroughbred Jerseys, 3 Guernseys; the others are grades. All the animals are stall fed. Many experiments in feeding have been reported in the bulletins of the college, and much information given on this topic.

Field Experiments.—One hundred and forty-four plots of one-eighth of an acre each have been set aside for some years past for continuous experiments. Many of them have been devoted to wheat, where the same variety has been grown for

several years on the same plot with different sorts of fertilizers, and also without any manure whatever. The results of these tests have been very instructive. Crops of timothy and clover cut at different periods of their growth have also been compared, and the results observed of special manures on the quality as well as quantity of the wheat crop.

Horticulture.—There is an orchard of twenty acres, containing many different sorts of apples, and a vineyard of about 500 vines, chiefly Concord, which usually yields a large crop. There is not much being done here in small fruits.

Miscellaneous.—A special course of lectures to farmers is given every year at the college, occupying two weeks. They consist of from thirty to forty in all, and embrace a variety of topics covering the whole field of agriculture and horticulture, and are specially designed to meet the wants of farmers actively engaged in their calling.

The amount annually expended for instruction is about \$18,000.

RHODE ISLAND.

The agricultural college land grant falling to Rhode Island was bestowed upon the Brown University, of Providence, in 1863, and in 1869 a department of agriculture and mechanic arts was organized in this institution. The endowment fund amounts to \$50,000.

The course of instruction in agriculture consists of lectures only, and includes the study of soils, economic geology, chemistry, botany, and other kindred subjects.

SOUTH CAROLINA.

The fund derived from the national land grant, amounting to \$191,800, has been invested in State bonds, and the interest, \$11,500, is divided equally between the South Carolina College of Agriculture and Mechanics, at Columbia, for whites, and the Claflin College, at Orangeburgh, for coloured people.

In addition to a course of lectures, a farm is attached to the Columbia College, where students acquire a practical acquaintance with farming operations under a skilled agriculturist.

The college at Claflin also gives instruction in agriculture, and has a farm of 116 acres, with suitable outbuildings, valued, in all, at \$10,000. The main work, however, of this institution, seems to be the primary education of coloured children.

TENNESSEE.

The University of Tennessee, located at Knoxville, received the endowment of public lands. The total sum of productive funds belonging to this university is \$405,000, the income from which is \$24,410; the annual expense of the teaching staff is about \$20,000; the remainder of the income is applied to current expenses. The estimated value of lands, buildings and appliances, is \$134,700.

A course of lectures is given on agricultural subjects. There is also a farm of 260 acres, well adapted for stock raising and grain growing, with suitable buildings and implements. The stock includes seven thoroughbred Shorthorns and two Devons. Several acres are devoted to experiments in growing wheat, oats and grasses.

As aids in the study of horticulture, there is an orchard of 300 trees, a vineyard, a small greenhouse and a flower garden.

TEXAS.

The State Agricultural and Mechanical College of Texas is located at College Station. The endowment fund from the national land grant is \$204,000; the land, buildings and appliances, are valued at \$260,000; the income is \$14,280; the expenditure about the same; the teaching staff costs \$12,000.

A special course of lectures is given in agriculture, including dairying, drainage, farm management, entomology and forestry. For practical illustration the college farm is used. It has 53 acres under cultivation, including 10 acres devoted to experimental plots and 11 acres to orchard.

VERMONT.

The proceeds of the national land grant to Vermont was \$135,500, which was given to the State University and Agri-

cultural College at Burlington. This institution has other productive property, its entire revenue being about \$22,000 and its expenditure about \$21,500, of which \$17,500 is spent in salaries. Agriculture is taught in a course of lectures associated with the kindred sciences of chemistry, botany, horticulture, dairying, entomology, etc. There is no experimental farm connected with this college.

VIRGINIA.

The endowment fund resulting from the national land grant to Virginia is \$285,000. Two-thirds of this sum was set apart for the maintenance of the Virginia Agricultural and Mechanical College at Blacksburg; the other third given to the Hampton Normal and Agricultural Institute. The Blacksburg College has a farm of 300 acres of land, well stocked, where experiments in agriculture, horticulture and stock raising are conducted. The land, buildings and apparatus, are valued at \$100,000. The total income is about \$20,000, of which the teaching staff receive \$14,000.

The course of instruction covers general agriculture, stock breeding, horticulture, chemistry, botany, the formation of soils, the elements necessary to a fertile soil, best methods of restoring lost fertility, necessity and methods of drainage, etc.

Hampton Normal Agricultural Institute.—This institution, which is located at Hampton, receives one-third of the agricultural lands endowment fund. It is an extensive establishment, affording accommodation for 500 pupils, designed for the instruction of the coloured youth, with the special object of preparing them to go out as teachers among their own people. The area of its work has been recently extended by taking in also the Indian youth.

The institute is chiefly supported by voluntary contributions from northern friends. From this source about \$30,000 is annually received; the interest on the land endowment fund is \$10,000; from other sources nearly \$5,000 more—\$45,000 in all, which is sufficient to meet current expenditure. About

\$30,000 is required for salaries of officers and teachers. The value of lands, buildings and appliances, is \$420,364.

Agriculture forms part of the regular course of this college. The students are also trained in practical work. The institute has two farms—one of 190 acres, and one of 600 acres—fairly well stocked with the necessary appliances. There are large orchards of apple, pear, plum and cherry, including 2,250 trees in all, which, with a vinery, nursery and small fruit plantations, afford ample means for instruction in horticulture. Eighty-three of the coloured students are said to be receiving special instruction in agriculture.

WEST VIRGINIA.

The West Virginia University in Morgantown received the national land grant. Its productive funds amount to \$110,000; the grounds, buildings and apparatus, are estimated at \$175,000. The annual income is \$6,500, to which the State adds about \$16,000 more.

The agricultural course consists of a series of lectures, covering two years, on practical agriculture and the allied sciences.

WISCONSIN.

The State Agricultural College of Wisconsin is a department of the University of Wisconsin, which is located within a mile of Madison, the capital of the State. The town is very prettily situated on elevated ground overlooking two lakes. The university is built on a still higher elevation, overlooking the town as well as the lakes. The endowment fund from agricultural lands is \$267,330; other productive funds amount to \$230,660—\$497,990 in all. The value of the grounds, buildings and apparatus, is placed at \$455,000. The land, which consists of 200 acres, is naturally well drained; the soil is clay loam, with a subsoil partly of clay and in part gravel. The special course in agriculture is very thorough, and is combined with practical work on the farm.

Stock.—The college herd consists of 25 head, some of which are pure Jerseys; others Jersey and Holstein grades. There

are two pure bred Jersey bulls, whose services are available to farmers in the neighbourhood for a fee of \$2. Nothing has been done in sheep or horses. A few pigs are kept, mainly for feeding experiments.

Field Experiments.—These have been continued under charge of Prof. Henry for a number of years, and include the testing of a number of varieties of corn, wheat and other cereals. Experiments on a large scale have been carried on for several years in growing amber cane for sugar making, and with ensilage.

Very little has been done in horticulture.

Chemical Laboratory.—This department is very complete, and, under the efficient direction of Prof. Armsby, is doing very thorough work in the analysis of fertilizers, fodders and grain used as food for cattle, the analysis of milk resulting from various kinds of feed, and particularly in digestion experiments. In these food of a certain character and known quantity is given, the excretory products are weighed and analysed, and the proportion of food assimilated accurately determined; also the manurial value of the excreta.

There are about 400 students in the university, but very few are availing themselves of the privileges offered in the line of agricultural education.

Revenue and Expenditure.—The entire income of the university is nearly \$83,000, a large proportion of which is spent in salaries of the teaching staff.

WASHINGTON.

Having reviewed in some detail the many items of State expenditure designed for the advancement of agriculture, reference will now be made to what is being done by the Federal Government in the same direction.

The appropriations for the current year for the distribution of seeds, plants and trees, and defraying the expenses connected with the scientific work undertaken by the Department for the promotion of agriculture, are \$408,810, exclusive of the special appropriations for the botanic garden of \$19,200.

The items may be thus enumerated :

Chemical bureau (salaries)	\$11,500 00
Chemicals and apparatus for the use of the chemists and microscopists, and for necessary expenses in conducting experiments	50,000 00
Entomological bureau (salaries)	7,900 00
Investigating the history and habits of insects injurious to agriculture and horticulture	20,000 00
Greenhouses, gardens and grounds	27,750 00
Microscopical bureau	1,800 00
Botanical bureau	3,000 00
Museum	4,120 00
Library, Dept. Agriculture, scientific works	1,500 00
Seed bureau (salaries)	8,240 00
Purchase, propagation and distribution of seeds, trees, shrubs, vines, etc., to be distributed in localities adapted to their culture	100,000 00
Tea plants, cultivation and distribution.	3,000 00
Forestry—to continue to experiment, investigate and report upon the sub- ject	10,000 00
Silk culture—encouragement and de- velopment of the culture and raising of raw silk	15,000 00
Bureau of animal industry	150,000 00
	<hr/>
	\$408,810 00

Most of the scientific work carried on at Washington is of a very high character and of great practical use. The yearly reports of the several bureaus are much sought and highly prized by all who are interested in the subjects on which they treat, and are a credit to the Government and the country.

As a further evidence of the estimation in which experimental work in agriculture is held in the United States, a Bill is now before Congress on which the House Committee on Agriculture have reported favourably, and which is likely to become law before the close of the Session, providing for the maintenance by the Federal Government of an experimental station in each State of the Union, by an annual grant of \$15,000 to each station. This will undoubtedly give a great impetus to experimental and practical work; and by providing the means for more general and extended investigations, agriculture will be materially advanced, the condition of the farmer improved, and the agricultural calling accorded, in public estimation, some measure of that dignity and importance to which, as one of the chief elements in national wealth and greatness, it is fairly entitled.

FORESTRY.

On the important subject of Forestry, I have been favoured with a communication from Mr. Bernhard E. Fernow, of New York, Secretary of the American Forestry Congress, one of the best authorities on this continent, a graduate of the Prussian Forest Academy at Münden, who served as Chief Forester under the Prussian Government for several years before removing to this country. His letter, which was kindly written at my request, contains so many valuable suggestions that I append it in full:*

“AMERICAN FORESTRY CONGRESS,
“OFFICE OF THE CORRESPONDING SECRETARY,
“January 12, 1886.

“WM. SAUNDERS, Esq.:

“MY DEAR SIR,—In reply to your request for my opinion in regard to the needs of forestry in the north-west Provinces of Canada, and to a plan for its introduction, allow me to say that a subject so important and complicated can hardly receive

* Since the appended letter was written, Mr. Fernow has been appointed Chief of the United States Forestry Bureau at Washington.

adequate treatment within the limits of a letter. Space, and my time for using it, being limited, my knowledge of the specific conditions of the region in question being only imperfect, and not derived from personal inspection, I shall content myself with giving you simply such general hints from the standpoint of a forester as may be useful in forming your own answer to the questions you ask.

"The subject of forestry in your country seems to me to have two distinct aspects. Forest conservation and the restoration of natural forests are required on the larger area, and mainly for economic purposes, while agricultural needs call for the creation of new forests in a more limited part of the Dominion, mainly, I believe, in the Provinces of which you speak.

"I assume that the climatic and hydrologic influences of forests in general are too well known to you to need discussion. That a permanently successful agriculture depends on a judicious distribution of forests is the natural consequence of those influences. As the improvident denudation of large forest areas in the Old World and on this continent has rendered those districts barren and unproductive and of no value for agricultural purposes, there can be little doubt that reforestation will be the best aid for restoring favourable agricultural conditions.

"Aside from the economic value of the wood-lot and the mechanical influence of the wind-break, retarding the velocity of surface winds and lessening the severity of blizzards, the most important effect of forest areas properly distributed lies in their hydrologic significance.

"They are the cheapest, the most reliable, the best irrigators. This office is due rather to a negative influence upon passing rain clouds. The forest does not prevent rain-fall, as does the open plain; for while the extensive, treeless plains present an air column, which, being dry and of high temperature, raises the point of saturation of a passing rain cloud, and allows it to pass without deriving the benefit of its moisture, the cooler air hovering over the forest tends rather to lower the point

of saturation, induces rain-fall on the neighbouring territory, so that the most helpful agency of the forests on agriculture is attained by their distribution, in belts or clumps, over the agricultural lands.

"The co-relation of forests and atmospheric moisture is such, that while the latter, to a certain degree, is a *conditio sine qua non* for forest growth, at the same time the growing forest tends to increase the atmospheric moisture of its surroundings, creating the very condition which it requires for its development.

"I consider, therefore, that the reforestation of the treeless and arid plains, and thereby their recuperation for agricultural uses, is, beyond doubt, not a difficult task, if begun judiciously, starting from the outskirts of the present forest area and reaching forward gradually with those species, which, like the cottonwood, soft maples, birches and others, will vegetate in the arid soil and dry atmosphere of those plains. These species may not be the most desirable for timber growth, and should therefore be replaced as soon as sufficient increase of favourable conditions is obtained, by undergrowing them with more valuable species, gradually removing the first crop, which had fulfilled its office by preparing the way for its betters.

"To accomplish the result—modification of climatic condition—the extent of such forests must be commensurate with the vast area needing the change, and it is questionable whether the individual efforts of small settlers will not be too isolated, and the results too limited and too remote, to be appreciably beneficial.

"But if the Government does not undertake such forest planting on a large scale, as has been done in European countries and is now practised in India and Australia, it would certainly be a wise policy to inaugurate and supervise systematic planting of forest belts or clumps as a condition of land grants from the public domain. But this would place the moral obligation upon the Government of providing at least all possible protection against failure, by gathering and

disseminating the necessary information on forest growing. Cautious and judicious proceedings are in no enterprise more necessary than in forestry, if financial results are of account. While agricultural experiments are answered in a year's time, or at least in a few years, the results of forestal operations cannot be ascertained until many years are elapsed. Mistakes are apparent only after generations have passed, especially when timber value or financial results form the main object.

"A few examples may illustrate my meaning. Some eighty or ninety years ago the American white pine was highly extolled in Germany as a desirable immigrant, and largely planted. To-day it is found that to attain the quality which we demand for building timber the white pine requires more than one-third longer time than the native Scotch pine. Whether the larger yield per acre will offset the amount of interest on the original outlay thus lost, is extremely questionable.

"Another mistake was the cultivation of birch in pure (unmixed) growth, which found its advocates some years ago. The results of this birch mania have been large areas impoverished under the thin foliage of the birch, which neither shades the ground nor enriches it with suitable humus, taxing the ingenuity of the forester to restore the soil to proper condition.

"The mistakes made in European forestry are frequent enough to serve as a warning for others to proceed more judiciously.

"I would not discourage the planters of walnut in our northern climes, who, from the rapid growth which the tree makes in the first ten or twenty years, calculate the prospective sawlogs of the forty year old tree; but it has impressed me more than ever with the importance of the work to which I was called for some time, namely, to ascertain the rate of growth of different species at different periods of their life, and the bearing of this on the financial result of their cultivation.

"To show you what such a small item as the distance of planting may have upon the ultimate results, I copy from my

note-book the following figures of an experiment. Thirty acres planted with Scotch pine in different widths, actual measurement, after twenty-five years' growth revealed these results:

Interval between plants.	Proportion of yield.
3 feet.	1.60
4.5 feet.	1.50
6 feet.	1.22
7.5 feet.	1.20
9 feet.	1.00

"Such examples may be used to show that forest experimentation cannot be expected to be undertaken by private individuals—at least, that systematic Government aid is necessary, if it is the interest of the Government to achieve results for the benefit of its constituents.

"Nowhere, it seems to me, are measures of encouragement by Government called for more urgently than in establishing systematic forestry in your country. Part of Canada's wealth lies in Canada's forests; the nature of the soil and climate in the northern districts of the eastern and central Provinces is, to a large extent, not fit for anything but forest growth. Yet Canada is utilizing the natural growth in such a manner as to deteriorate her forest capacity, and often even her agricultural possibilities. Timber growing will eventually become an economic necessity for Canada; few lumbermen, under existing conditions, can see any advantage in utilizing supplies with other views than those of immediate gain—a man's life seems too short to enter upon such extended enterprise as forestry—interest in future supplies can concern the State alone; at least, so it seems at present.

"The time for a wiser forest policy has come, and the Government should lay now, while it still retains land and forest, the foundation of systematic forest management—at least to set, as in Germany, the example after which private owners may form their forestry.

"There seems to be a misunderstanding as to the position which the different Governments of Germany hold in respect

to their forests. Only one-third of the entire forest area is State forest; not quite one-fifth, belonging to communities, is under restrictive State supervision; and the balance, very nearly one-half (in Prussia 53 per cent.), is in private hands, to the unrestricted use of their owners, excepting a few cases, where the danger to neighbouring agricultural lands from the indiscriminate removal of the forest makes its management under restrictive rules necessary. Yet the good example set by the management of the Government forests has largely induced a similar management of private forests by their owners, who frequently employ the neighbouring Government officer, at a small remuneration, to make their working plans.

"In Germany, where empire forestry has been practised for more than two centuries, the necessity of experimentation upon a scientific basis, though recognized long ago, has found practical expression only recently. France has followed, and we may say that with the year 1870, when the first experimental stations were established, one in Baden and another in connection with the forest school at Tharana, in Saxony, a new epoch in the art of forestry has been inaugurated.

"The other Governments soon followed, so that there are now eight central forest experiment stations, with a large number of secondary stations. All these, except the Austrian, have formed a union, called the Association of the German Forestal Experimental Stations, and work under a common plan harmoniously together, to furnish a scientific foundation for a rational management of forests, based upon exact experiments and careful investigation.

"Your Government may congratulate itself that it can build upon the experience of older nations. For although European administrative methods and local management may not be translated into Canadian practice, their study will be no small aid in devising a system for your own use. As for their methods of scientific research, and for the establishment of the general natural laws governing forest growth, we may not hesitate to adopt the former and apply the latter as well in forestry as we do in agriculture.

"The natural laws being uniform all over the world, their practical application will depend only on sound judgment of local conditions. These we have to study here. What we do not know, and cannot learn from the extensive European libraries of forestal literature, is the capacity of our native species—not less than 95 in Canada (some 20 only in Germany); their rate of growth in different periods of life; their adaptability to conditions of soil and climate; the best mode of propagation and treatment in the forest generally; the time of their maturity; their value as timber; their value as conservers of forest capacity; their yielding capacities; their behaviour towards each other (a most important and, in this country, almost entirely disregarded consideration for the forest grower); and many other points essential to a successful forestry. In the face of the utter ignorance on the forestry of our native species, I will not mention the subject of acclimatization of desirable foreigners.

"Close observations and scientific experiment are needed to arrive at this fundamental knowledge.

"In this work one point particularly should not be overlooked, namely, that observations on tree growth for use in forestry must be made under forest conditions. The nurseryman and gardener have very different objects in view. They work under different conditions; their experiences may often mislead the forester, and their methods, in most cases, he cannot adopt. If anything, therefore, is to be accomplished in forest experimentation, the experimenter must study forest conditions, and employ them in his experiments.

"I see that the Dominion Lands Act, as amended, provides for reservations on the slopes and crests of the Rocky Mountains for the purpose of preserving an even water supply. Such reserves should be placed under the same direction as the eventual forest experimental stations. Other reserves in the plain, giving the opportunity of studying different forest conditions and of applying conclusions for practical results, are not only an essential adjunct to forest experimentation, but may eventually form the nucleus for systematic forest economy.

"Such reserves, while in the first place designed to serve as experimental grounds, should be made large enough to establish and support a regular forest department, and, with a conservative policy, may be so managed as to demonstrate financial possibilities, and could in time be made to pay for the expenses of all forest experimental stations. Germany, with a forest area of 35,000,000 acres, of which only 33 per cent. are State forest, expends on experimental stations alone in the aggregate over \$30,000, out of which only few salaries are paid, the experimenters being otherwise paid officers. Experimentation in forestry then, as in agriculture, is of a double character, the nursery and forest garden in connection with the botanical laboratory corresponding to the laboratory of the agricultural chemist, while the model farm finds its counterpart in the natural forest and the plantation.

"It would lead me too far to enter into the details of organization, except to say that centralization of the work is a necessity, and that the central station should be connected with agricultural colleges or experimental stations, where the aid of scientific apparatus can be most readily and cheaply secured. Forestry being based, somewhat similarly to agriculture, upon a knowledge of natural sciences, the aid of the scientific staff of such institutions would be an advantage; specialists in botany, chemistry and technology, geology, etc., can be directed to give attention to their subjects as related to forestry, and occasional or regular lectures on forestry matters, by the forest director and his staff, will soon engage close attention from the students of agriculture, and practical application in the management of their wood lots at home.

"I hope you will find in the foregoing suggestions something to aid you in deciding whether and how your Government should take steps to provide for the future, not only of Canadian forests, but also of successful agricultural settlements on the treeless plains. If I can aid you further, please indicate in what manner, and I will cheerfully do so.

"Yours very truly,

"BERNHARD E. FERNOW."

Forestry Expenditure in Germany.—I add, as an interesting item from the Budget of Prussia (the most economical of the German administrations), for the year 1st April, 1885-86, the following figures (rounded off):

Total expenditure for State	\$315,000,000
Total area	86,000,000 acres.
Total State forest area 6,600,000 "	"
Total expenditure for Forest Department	8,250,000
Of which special appropriation for purchase of waste lands and removal of easements	575,000

Of balance for administration—

Personal (4,600 officers of all grades) . .	34 per cent.
Material	58 "
General expenses	8 "
For forest schools and scientific purposes	\$ 48,250
Total gross receipts of Forest Department	13,250,000
Of which, for wood (260,000,000 cubic feet)	11,700,000
Net income from Forest Department .	5,000,000

II.—AGRICULTURAL COLLEGES, EXPERIMENTAL STATIONS AND SCHOOLS OF HORTICULTURE AND FORESTRY IN EUROPE.

In further proof of the fact that there is a general movement in most civilized communities to encourage research and experiment, and to provide and impart information with the view of promoting agriculture, a few facts will now be submitted relating to some of the schools of agriculture, horticulture, experimental stations and schools of forestry in other countries.

During the autumn of 1883 Prof. A. S. Welch, late President of the Agricultural College of Iowa, visited Europe at the request of the Commissioner of Agriculture for the United States, for the purpose of inquiring into the organization and management of the principal agricultural schools in England, Germany and Belgium. He remained some months, and on his return, in 1884, submitted a report, recently published by the Department of Agriculture in Washington, from which much of what follows has been gleaned.

ENGLAND.

ROYAL AGRICULTURAL COLLEGE AT CIRENCESTER, ENGLAND.

This well-known institution was established in 1845 by a company of noblemen, headed by the late Prince Albert, and was incorporated at the same time under a charter granted by Queen Victoria. By the sale of corporation shares a sufficient sum was realized to erect the main college building, which is an imposing Gothic structure, located a mile and a quarter from Cirencester. The building has a frontage of 200 feet, and contains the apartments of the resident professor, students' dormitories, library, lecture rooms, laboratories, museums, etc.

In 1880 the institution was first named by Her Majesty the "Royal Agricultural College of England." The formal patron is the Prince of Wales, and the Duke of Marlborough is President. The college has no endowment fund; its support is wholly derived from students' fees and the patronage of the association.

There are about 70 students, 50 of whom reside in the college; the others are out-students, who board in the town. The in-students pay £135 (\$658) per annum; the out-students, for tuition alone, £75 (\$365).

The instruction consists of courses of lectures on practical and scientific agriculture, mechanical work of the farm, experiments in the field and veterinary hospital practice. With these subjects are associated chemistry, geology, botany, zoology, mechanics, physics, mensuration, practical engineering, land surveying, book-keeping and architecture. The students composing the classes take careful notes on the topics presented to them, then consult works of reference, and prepare themselves for a weekly written examination, by the results of which their standing is in part determined.

The chemical laboratory is thoroughly equipped and the studies directed by a staff of competent teachers, who instruct the students in chemical processes, particularly the analyses of substances associated with agriculture.

In the lecture room is a collection of wheat plants, with roots and heads well preserved, showing the results of an experiment by Sir J. B. Lawes, of Rothamsted, on a single variety of wheat cultivated for nineteen successive years in twenty-eight small plots, one of which received no manure, while the others were annually treated with definite quantities of special fertilizers. In this manner, by nineteen repeated applications, the exact effect of every fertilizer was ascertained and a most instructive series of specimens secured, the unmanured examples showing about half the size and weight of those best manured. The relative size and yield of the different samples showed that super-phosphate of lime and ammonia salts produced the best results.

The biological laboratory is well supplied with microscopes and other apparatus.

An excellent botanic garden is an interesting feature; it is well stocked with plants, especially with grasses and other economic species.

A large museum is another valuable aid. It contains a full collection of commercial fertilizers, forage cakes, including those made from hemp, rape, palm, cocoanut, cotton and flax seeds; also a collection of sugars, starches, animal and vegetable oils and mineral phosphates. An interesting feature is a series of wax models representing English root crops and a large number of neatly preserved British grains and cereals. The veterinary display is also large, including a set of papier-maché models for teaching the anatomy of the domestic animals.

The department of physics is well fitted with apparatus for illustrating the subjects of light, heat, electricity, etc. The prominence given to model engines, pumps, water-wheels and other mechanical appliances, indicate that the practical relations of this department to agriculture are fully recognized.

The college farm consists of 500 acres of land divided into twenty fields, in which are raised a great variety of crops on an approved system of rotation. In the stock department a specialty is made of Cotswold sheep and Berkshire pigs, and some of the most perfect specimens of these breeds, as well as good specimens of all the other leading breeds of sheep in the world, are to be seen here. Horses and cattle are also bred, but to a more limited extent.

DOWNTON COLLEGE OF AGRICULTURE.

This college, located at Downton, near Salisbury, was established, in 1880, for the purpose of preparing students for positions of land owners, farmers, etc. The farm comprises 550 acres, and on account of the variability of its soil, is well adapted for purposes of instruction. A flock of Hampshire Down sheep, numbering about 700, is a prominent feature in the stock department at this place.

Both Professors Fream and Sheldon, well known in this country from their writings on the agricultural resources of Canada, are actively engaged in this college.

The courses of lectures are very similar in character to those of the Royal College of Agriculture, and cover the whole field of agriculture and the allied sciences, the teaching being aided by well-fitted laboratories, with the newest forms of apparatus. In this college students are required to work in the fields and to help in the management of live stock.

The expenses, including board, lodging and tuition, are £129 (\$628) a year ; for students boarding outside the college, £60 (\$292).

FRANCE.

Rapid progress is being made in experimental agriculture in France. From the report of the Select Committee of the House of Commons, already referred to, much of the following information is gathered.

In 1868, the Minister of Agriculture, of France, commissioned a gentleman well versed in agricultural science, Mr. L. Grandeau, to visit the agricultural stations of Germany, and "to report on the working of these institutions, on the services which they rendered the German population, and as to the advantage there would be to French agriculture by encouraging the creation of analogous establishments." He returned full of admiration for these agricultural stations, which he describes as producing the happiest results, and further says : "At whatever cost, our farmers must be made familiar with the art of experimenting. In a word, it is henceforth indispensable that agriculture, which in our country has been hitherto a science of observation, should become at the same time an experimental science. In this manner, and in this manner only, can be reached better conclusions which will be more abundantly remunerative, and which will more than compensate the increased labour which the husbandman will undertake in following the new order.

"The manifest demonstration of the profit resulting to agriculture from the union of chemical science and physiological experiment which was realized at the stations, made impression every day more and more, on practical farmers. The mistrust of those whom they called the learned lessened from day to day, and they hastened to come and ask, at the station, counsel and instruction as to those things in their daily labours on which they most wanted information."

Following this there were, in the year 1878, in France forty-three agricultural experimental stations subsidized by the Government; twenty-four received from 1750 to 16,467 francs each, and nineteen from 500 to 3,000 francs.

To France is also due the credit of having solved the difficult problems which formerly stood in the way of the beet sugar industry, a result brought about chiefly by the liberality of the French Government. In the encouragement of tree planting France has also taken a prominent part, and some portions of her territory once barren and arid are now clothed with a luxuriant growth of pines.

GERMANY.

THE ROYAL AGRICULTURAL ACADEMY AT POPPELSDORF, NEAR BONN, PRUSSIA.

The Royal Agricultural Academy belongs to the highest class of agricultural schools under the Prussian system. It aims to give a complete course of instruction in the sciences on which progressive agriculture is based, as well as practical instruction in all the details involved in agricultural operations. It also undertakes to carry on extensive experiments in every department of agriculture, for the purpose of improving its processes and increasing the value of its products, and aims to make original investigations in the sciences which underlie agriculture.

To accomplish these objects the institution is liberally supported by the German Government. It has a faculty of learned men, a well-managed farm, gardens, extensive experi-

mental grounds and stables, domestic animals, a museum, a botanic garden and conservatories, and numerous laboratories, in charge of scientific experts, abundantly supplied with scientific apparatus.

The faculty consists of a Director and 18 professors, each of whom has one or more assistants. There are also other officers and clerks to attend to the routine business.

The Director is the general executive officer, has control of all the funds appropriated by the Government for the support of the academy, and reports annually to the Minister of Agriculture.

The course of instruction is for two years, and is not open to the peasantry; only the middle or higher classes can avail themselves of its advantages. The usual attendance of students is about 85; more than half of the number take the agricultural course; the others take the course of agricultural engineering.

Some idea can be formed of the extent of the experimental work undertaken at this academy, when it is known that in winter wheat alone 600 varieties have been tested, so as to ascertain the kinds best adapted to German soils; also, 650 varieties of American, English and German potatoes for the same purpose. In many other departments similar exhaustive courses of experiment have been pursued.

THE ROYAL INSTITUTE FOR FRUIT AND WINE CULTURE.

This institute, which was established by the Prussian Government twelve years ago, is situated at Geisenheim, on the Rhine, at the centre of the grape-growing district.

The faculty consists of four professors, all of whom are well trained in science, and have assistants and gardeners. The experimental grounds are large and well stocked, each division being placed in charge of a special expert. The buildings, museum, laboratories and other are ample, convenient and well adapted to their several purposes, and an excellent library is kept well supplied with books. In this establishment the number of students is limited by law to 50.

While mainly designed to give instruction in fruit culture, this institute also includes in its course vegetable culture, market gardening and, to some extent, tree-growing. Special attention is given to the cultivation of the grape and the manufacture of wine; also, to the growing of apples and pears.

In the experimental apple orchard there are nearly 400 varieties, which are being tested for comparative excellence, both standards and dwarfs; 400 varieties of pears, 60 of plums, 50 of peaches, and 24 of apricots, all of which, as they fruit, are submitted to careful comparison by qualified experts. In the small fruit section there are 66 varieties of gooseberries, 45 of raspberries and 100 of strawberries.

In the experimental vineyard 350 varieties of grapes from all parts of the world are being tested as to their productiveness, their quality for table fruit and for wine making. Here also are greenhouses and propagating houses affording every facility for multiplying desirable sorts for more extensive experimental work.

The immense expense incurred in carrying on these schools for so limited a number of students, and that number being limited by law, would seem to indicate that a much higher value is attached to the general results of the experimental work, of which the entire public receive the full benefit in the yearly reports, than to the teaching given. Further, with so large a teaching staff, and so comparatively small a number of students, the teaching can be carried on either by the professors or their assistants, without interfering much with experimental work.

BELGIUM.

THE ROYAL FOREST SCHOOL OF BAVARIA.

This school, which is situated at Aschaffenburg, affords very thorough instruction in forestry. In addition to a full staff of professors, who give instruction in all the sciences grouped around wood craft and forestry, there are large museums and

excellent laboratories supplied with all sorts of scientific instruments. Here there are 85 students.

AGRICULTURAL EXPERIMENTAL STATIONS.

In Belgium there are also nine agricultural experimental stations, supported jointly by the Government and the local agricultural societies. The work carried on at these stations is chiefly chemical. In the station at Ghent, which may be taken as a type of the group, there is a director, a chemist and three assistants; a chemical laboratory, well supplied with apparatus for conducting analytical work, a stable and a feeding room.

At these stations analyses are conducted of foods and of products from the farm, of grasses and fodders used for the production of flesh or milk, for the purpose of determining their comparative value; also of manures, but more particularly the commercial fertilizers, such as are purchased and used by the Belgian farmer.

Formerly the small farmers of that country were shamefully imposed on by the vendors of spurious fertilizers and cattle foods, the deficiencies in which they were unable to detect until after they had sunk a large part of their means in testing them. Now, through the agencies of these useful institutions, the farmer can have determined for him beforehand the actual value of all such substances, and thus be protected from imposition.

The sugar beet is grown in large quantities in Belgium from imported seed, some samples of which are much adulterated with old and worthless material. The stations have rendered most valuable service to the farmers by testing the vitality of the various lots offered in the market, and have thus been the means of preventing, in large measure, the waste of labour and other losses which attend the use of worthless seed.

Feeding experiments have been most carefully conducted with different breeds of animals, and the results made public. The officers of this station have also devoted some attention to counterfeits in commercial fabrics, determining the precise

quantity of cotton in mixed goods. No teaching is carried on at any of these stations.

THE HORTICULTURAL SCHOOL AT GHENT.

This is one of two such national schools supported by the Belgian Government. The board of instruction consists of seven professors, and the course of study extends over three years. The number of students is limited to 25.

At this school the cultivation of flowers is a prominent feature, receiving the principal attention both as to instruction and practice. On this account much time is devoted to botany. As aids to study, there are large collections of plants in the conservatories, and an immense herbarium of 30,000 specimens, comprising species from all parts of the world. Collections, charts and casts illustrate the structure and character of flowers and fruit, while a number of excellent microscopes enable students to investigate the minute structure and tissues of plants. There is a large propagating house, where instructions are given in that part of the gardener's art, and many experiments are conducted. Bulb culture, which is an important commercial branch of floriculture in Belgium, is thoroughly taught at this school.

The conservatories are very extensive. The main structure is 250 feet long, 60 feet wide and 40 feet high. This is stocked chiefly with tropical plants. For such as require a lower temperature, another glass house is provided, 200 feet long and 30 feet wide. A special house has also been built for orchids and aquatic plants.

OTHER COUNTRIES.

To pursue in detail the work being carried on in other countries in furtherance of agriculture would probably be wearisome, since a volume would not exhaust the subject, and the work is everywhere much alike in its character. A few general remarks will enable the reader to form some idea of the extent of the work quietly going on in many countries,

some of which are supposed, by the uninformed, to be behind in such undertakings.

The agricultural college at Petrovsk, near Moscow, in Russia, is very large, well conducted and well patronized, and is supplied with every requisite for efficient teaching. It has 1,200 acres of land, with nurseries, arboretum, forestry belts, etc.; an excellent selection of stock is kept, and all kinds of field crops grown. About 800 students are in attendance.

Other agricultural and pomological* institutions are also doing good work in that country. The botanic garden at St. Petersburg, under charge of Dr. Regel, ranks among the largest and most complete in the world. In forestry Russia has made enormous progress, and has now, according to Professor Budd's report, no less than 12,502 named forests, covering 30,000,000 of acres. There are 762 large Government forestry stations throughout the Empire, under the charge of an equal number of educated directors. In the Steppe districts much land, formerly barren, owing to insufficient rain-fall, has, within the last half century, been brought into condition for cultivation by the planting of tracts of forests of from 15,000 to 30,000 acres each, which has had the effect of inducing local rain-fall sufficient to admit of successful agriculture. In one Province, that of Tula, where but little wood formerly existed, the Government has seven plantations, ranging in size from 18,000 to 21,000 acres each.

In Silesia, the King's Pomological Institute at Proskau is one of the best schools of horticulture and forestry in Europe, where 300 acres of land are devoted to testing all the hardiest fruits of northern and eastern Europe; and similar institutions exist in almost every country on that continent.

In Ireland a system of agricultural education has been recently introduced into the elementary schools, which is full of promise. The schools are associated with school farms and gardens, where children are taught the principles of agriculture and horticulture.

In a recent report it is stated that from 45,000 to 50,000 children are annually examined as to their proficiency in

agricultural studies, and that about half that number have succeeded in gaining passes for their proficiency in this branch. The Albert Agricultural Institute at Glasnevin, besides carrying on other good work, is training teachers for that purpose, and all those now engaged in elementary schools in Ireland are required to pass an examination in this subject before entering on their duties. Were some such measure as this adopted in Canada, and the interest of children of all classes awakened by presenting to their minds some of the more attractive features in agricultural pursuits, there is every reason to believe that the effect on agricultural progress would be very marked in a single generation. The Munster Agricultural and Dairy School is rendering eminent service to farmers in the county of Cork.

A large number of agricultural experimental stations have been established in different parts of Germany, some eighty in all; many similar stations are in active operation in Austria, Hungary, Italy and other countries of Europe, most of them supported or subsidized by the respective Governments. The growing of timber on a large scale has engaged the attention of many of those countries, and is also being carried on in a very large way both in Australia and in India.

Japan, too, is moving in this matter. Some years ago the Japanese established agricultural testing farms near Tokyo, where trees, shrubs and fruits from foreign countries were grown, and the most promising sorts propagated and disseminated. Recently the Japan Government has engaged the services of an eminent American agriculturist for a term of years, at a liberal salary, for the purpose of establishing, in the Japanese Empire, experimental agricultural stations on the American plan.

III.—AGRICULTURAL EDUCATION AND EXPERIMENTAL WORK IN CANADA.

ONTARIO.

The Ontario Agricultural College is the only institution of its kind in Canada. It is located about one mile from the city of Guelph. The buildings occupy a commanding position, overlooking the farm and the city. The farm consists of 550 acres, which was purchased in 1873 at a cost of \$75,000. From the report of the college for 1882 we learn that the total cost of land, buildings, live stock, implements and drainage—all of which is charged to capital account—up to the end of 1880, was \$225,889.46. Subsequent reports and annual statements of the public accounts of the Province show the following additional sums expended in excess of revenue:

To 31st December, 1881.....	\$56,324 39
do 1882.....	51,050 46
do 1883.....	55,801 86
do 1884.....	90,291 93

From these expenditures there is chargeable to capital account the following sums:

In 1881.....	\$27,859 95
1882.....	15,353 09
1883.....	12,400 68
1884.....	52,512 93

Total.....\$108,126 65

Which, added to the amount given above, makes the investment on capital account to the end of 1884, \$334,016.11. Deducting the moneys charged to capital account each year from the total expenditure, the account stands as follows:

EXPERIMENTAL FARM STATIONS.

85

1881.—Expenses of teaching college, as stated in college report over and above revenue.....	\$14,986	85
Expenses of experimental farm...	13,477	59
	<hr/>	
	\$28,464	44
1882.—Expenses of teaching college	\$18,315	95
do experimental farm	17,381	42
	<hr/>	
	\$35,697	37
1883.—Expenses of teaching college	\$18,797	97
do experimental farm	24,603	21
	<hr/>	
	\$43,401	18
1884.—Expenses of teaching college	\$19,760	56
do experimental farm	18,018	44
	<hr/>	
	\$37,779	00

This points to an average net expenditure on maintenance account for the past four years of \$36,335.47, and on capital account of \$27,031.66.

The land is utilized as follows: College and ornamental grounds, 45 acres; garden, 5 acres; experimental grounds, 24 acres; orchard, 20 acres; under general cultivation, 324 acres; natural pasture, 60 acres; bush, 65 acres; roads, 7 acres.

All college expenditure is controlled by the Principal: the farm expenditure by the Professor of Agriculture. In the estimate of farm expenses the large sums paid for student labour are included, as follows:

For 1881.....	\$5,202	61
1882.....	4,421	68
1883.....	4,000	42
1884.....	4,234	98

As this labour is no doubt paid for at a much higher rate than its intrinsic value will warrant, it remains an open question as to what proportion of it is fairly chargeable to the farm account.

On the other hand, the salary of the Professor of Agriculture is charged entirely to the college account, whereas much of his time is necessarily occupied in superintending the work on the farm.

The Faculty consists of six professors, with salaries varying in amount from \$1,200 to \$2,000 each, the heads of the two departments receiving, in addition to their salaries, furnished houses, horses, servants and table supplies.

The number of students at present attending is 91. In the course of instruction agriculture occupies a prominent place, in connection with lessons on live stock, dairying, arboriculture, chemistry, veterinary science, botany, entomology, English literature, book-keeping, etc. The full course covers a period of two years, each year being divided into four terms, one of which is devoted entirely to work in the outside department. During each of the other three terms, extending in all from the first of October to the 1st of June, there are regular courses of lectures, associated with a certain amount of outdoor work. The number of hours of compulsory labour has lately been reduced, and students now spend one hour each morning and every alternate afternoon in this department. The number of graduates during the past four years, as given in the report for 1884, is as follows: For 1881, 9; 1882, 19; 1883, 9; and for 1884, 11.

Stock.—No institution in America can compare with the Ontario College in the variety and excellence of its stock. All the best breeds are represented here—Durhams, Herefords, Polled Angus, Galloways, Jerseys, Ayrshires, Holsteins, Devons and Guernseys. These breeds are each represented by a bull and two cows, recently imported. There are also specimens of the West Highland breed of cattle, which is said to be valuable for its hardiness, but is rather slow in maturing; besides which there are two Quebec native cows, which are good

milkers; these are about the size of Jerseys, and by crossing them with pure-bred Jerseys, it is expected that a grade animal very valuable for milking purposes will be obtained.

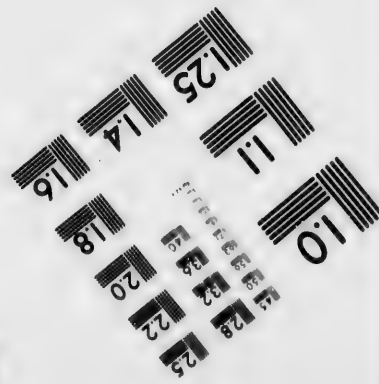
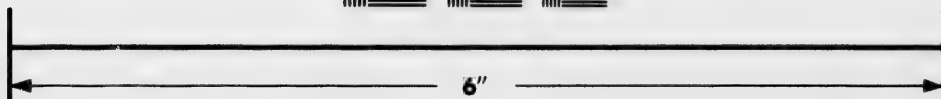
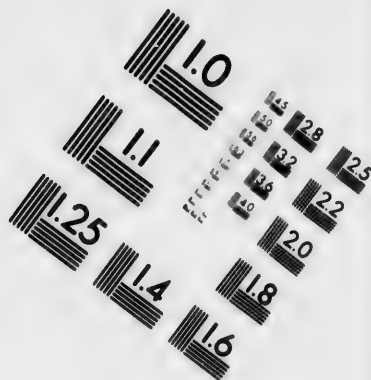
The different breeds of sheep are also well represented by newly imported stock, the number, in most cases, being two rams and three ewes of each. The collection includes Cotswolds, Oxford Downs, Hampshire Downs, South Downs, Shropshires, Lincolns, Black-faced Highlands, Lesters, Merinos and Cheviots.

In pigs there are two sows and one boar of each of the following breeds: Berkshire, Essex and Middle York. The services of male animals continue to be given to farmers, the charges varying from \$1 to \$10. This is said to cause some dissatisfaction among prominent breeders of thoroughbreds, whose charges for such services are higher. Experiments in cattle feeding have been carried on for eight or nine years, but have now almost ceased, dairying occupying most attention.

Field Experiments.—Twenty-four acres are devoted to experimental work, divided into 180 plots of one-tenth of an acre each, with suitable spaces between them. The situation of this field is low, and hence unfavourable for grain culture, but is well suited for grasses, and answers fairly well for roots. In the centre of these plots there is a small building for meteorological observations, supplied with an excellent rain gauge and a series of soil thermometers. Part of the interior is fitted up as a chemical laboratory, supplied with apparatus for the analysis of soils, milk, etc.

Forty varieties of cereals have been experimented with during the past year, and four sorts of peas. The experiments with grasses have been satisfactory, and seem to have established the value of some varieties for permanent pasture, especially the meadow fescue, meadow foxtail and perennial rye grass.

Many experiments with ensilage have been conducted, and the conclusion reached, that where roots can be advantageously grown ensilage is not much needed; but where circum-



Photographic Sciences Corporation

28 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

14 28
12 32 25
10 22
8 20
6 18

10
11
12
13
14

stances are adverse, and difficulties stand in the way of thoroughly drying such fodder as may be grown, this mode of preservation may be useful.

Horticulture.—There is an apple orchard of over 10 acres, with about 80 varieties of trees; one of cherries and plums, of 2 acres with 50 varieties; five acres of small fruits, including strawberries, raspberries, gooseberries and currants. The vinery covers three acres, and has about 80 sorts; last year was the first year of bearing.

The five acres of vegetable garden are bordered with fruit trees and vines.

Greenhouses.—There are three glass structures, one used as a conservatory, one as an intermediate house, and one as a propagating house. These are very plain buildings, about 30 feet in length, heated by brick flues, which smoke to that extent that it is almost impossible to grow hard wooded plants; they are very poorly adapted for the purpose for which they were designed. These houses are used partly as a means of instruction, but chiefly for the raising of bedding plants for outdoor decoration during the summer.

Tree Clumps.—There are five of these in all, covering about half an acre each. The trees have been several years planted, and most of them are now making fair growth. The varieties are black walnut, sugar maple, European larch, butternut and one mixed clump.

Arboretum.—This is situated partly in front of the buildings and partly in the rear. The groups consisting of the smaller trees and shrubs are planted on a lawn of about 12 acres in front of the buildings, and the larger trees arranged in the rear, where, when the planting is completed, they will occupy fully 10 acres. They are grouped in their natural orders, some twenty-five orders being represented in the collection. Most of the shrubs and trees, although still small, have made fair growth, and the arboretum now contains about 300 species and varieties in all.

A collection of herbaceous plants has also been procured, consisting of about 200 species and varieties, and there is a

small nursery for propagating young stock and growing trees for the arboretum and ornamental grounds. These collections are found to be very useful for teaching purposes, while at the same time they add much to the appearance of the grounds.

The altitude and location of Guelph are such as to render the climate unfavourable to the growth of many of the less hardy sorts of trees and shrubs, which can be successfully grown in the more favoured districts of Ontario. This has caused disappointment in many instances, when the attempt has been made to introduce half hardy things.

A course of instruction is given in practical horticulture, including grafting, budding, potting, etc.

Mechanics.—These are taught to a limited extent, but sufficient perhaps for the requirements of a farmer; but the buildings need enlarging and improving, in order to give the requisite facilities. The carpenter's shop is fitted with four benches, affording accommodation for eight students at a time; a blacksmith shop is also being constructed, with two forges.

Laboratory.—A large room in the main building is used as a combined laboratory and lecture room, with accommodations for giving practical instruction to 30 students at a time. This is insufficiently lighted, poorly equipped, and inconveniently situated. So important a department should have a detached building for its own use.

Reading Room and Library.—A large, commodious and well-lighted reading room is provided, with 42 papers, journals and magazines, including all the leading Canadian, British and American periodicals. The library, which is being constantly augmented, consists of 5,000 volumes, and includes a large number of works on agriculture, horticulture and veterinary science.

Museum.—A general museum has been established in a large room in the college building, and contains upwards of 3,000 specimens illustrating agricultural and horticultural products, botany, geology, entomology, mineralogy and zoology.

Experimental Dairy.—This is a small building in which dairy products are made on a small scale, and where the proportionate produce of cream, butter and cheese contained in the milk of different breeds of cows is tested. By means of a centrifugal separator of one horse power, the cream from the milk of 15 cows can be separated in an hour. Lectures are given on this subject twice a week throughout the winter.

Creamery.—The creamery has only been in operation for one year. It is under separate management, and is conducted in a building on a distant part of the farm, without reference to the college stock or the college requirements as to butter supply, but students have the opportunity of visiting it and observing the manner in which the operations are conducted. The cream is collected almost wholly from farmers in the neighbourhood. It is gathered once a day and churned the following morning. Eight teams are employed during the season, which lasts from about the 15th of May to the 15th of October, the route extending from seven to ten miles. During the most productive period the yield of butter is said to have averaged 600 lbs. per day, and the product has been of such a quality that while ordinary farm butter commanded not more than 12½ cents, this averaged 19½ cents throughout the season. It is asserted that this creamery has thus far been so conducted as to pay all working expenses and leave a small margin of profit. There has been ready sale for all the butter made.

Other Organizations.—Excellent work has been done by the Fruit Growers' Association of Ontario by distributing among its members promising fruit trees, vines, etc. In this way the whole Province has been made a testing ground; many excellent varieties have been tried and thus brought prominently into notice. Fruit culture has been further promoted by the publication of the annual reports of the association, which are always full of useful and practical information.

The Entomological Society of Ontario has also rendered eminent service to farmers and fruit growers by disseminating among them information regarding injurious insects affecting

both field and garden crops, with suggestions as to the most useful remedies. Both these societies receive yearly grants from the Provincial Government.

QUEBEC.

Mr. E. A. Barnard, Director of Agriculture of the Province of Quebec, writes as follows:

"The Province of Quebec subsidizes three farms, giving to each \$2,000 annually, besides paying the board of ten students in each school at the rate of \$60; besides an allowance to as many students of \$40 each, which they can earn for themselves by labouring on the farm.

"Neither of these establishments, however, can properly be called 'experimental' or 'stock farms.' Very few experiments, if any, have been made; and the stock, although good of its kind, is by no means remarkable.

"All these provincial schools stand on the same basis exactly. The farm and schools, etc., belong to the Corporation of the College at St. Ann's, Richmond and L'Assomption. They have each but one regular professor—that on agriculture, although a few lectures are given in the course of the year by outsiders. These corporations manage pretty much as they please. A Board of Inspectors is sent annually by the Council of Agriculture to visit the school, and the grant is paid after this inspection."

In addition to what has been accomplished at the college farms referred to, much praise is due to Mr. Chas. Gibb, of Abbotsford, for his self-sacrificing individual efforts in furthering the cause of horticulture, not only in Quebec, but also in Manitoba and the North-West Territories. He shares with Prof. Budd, of Iowa, with whom he travelled to Russia, the credit of having thoroughly investigated the subject of hardy Russian fruits, and settled the question as to their quality and extreme hardiness. By his writings he has done much to impress upon the minds of the fruit-growers, both of the United States and Canada, the importance of introducing many of these fruit and forest trees to be tested in the colder

climates of this country. Mr. Gibb has combined practice with theory, and having seen and tasted the fruits of north-eastern Russia, and studied the climatic conditions to which the trees are there exposed, he has imported and is testing many of them on his own farm, and is fully convinced that there are many varieties of both fruit and forest trees which, if they were disseminated, would be a great boon to the settlers in the north-west country.

Mr. Gibb is testing 30 varieties of apples, 49 of pears, 10 of cherries and 4 of plums, the greater part of which are from Russia, the others from North Germany and Poland.

The annual reports of the Montreal Horticultural Society have been full of useful and instructive matter relating to all branches of horticulture. The officers and directors of this society deserve much praise for the able manner in which its affairs have been managed, and for the valuable information which they have collected and disseminated. This society is subsidized by the Quebec Government.

NOVA SCOTIA.

The Fruit Growers' Association of Nova Scotia has been actively engaged for many years in distributing information relating to fruit growing in that Province, and has succeeded in stimulating that department of industry to a remarkable degree. The increased exports of fruits of late years from this Province are due, in a great measure, to the activity of this useful association, and the devotion shown by the officers and members in their efforts to extend and promote the cultivation of fruit.

NEW BRUNSWICK.

In the report of the Select Committee appointed by the House of Commons to obtain information as to the agricultural interests of Canada, we find a statement from Mr. J. L. Inches, Secretary of Agriculture for New Brunswick, in reference to what has been done to aid agriculture in that Province, as follows (p. 30): "Some three years since the Government imported a number of cattle, sheep and swine, and placed

about 30 cattle, 40 sheep and 6 swine on a farm, as the beginning of a stock farm. With the exception that the farm selected has not proved suitable, this act on the part of the Government has been much approved, and the short experience we have had of it shows that we can supply our farmers with a larger number of fine animals for the same amount of money than by importing." There is no evidence that any experimental work has been undertaken on this farm, beyond stock raising.

DOMINION DEPARTMENT OF AGRICULTURE.

With reference to what has hitherto been done by the Dominion Department of Agriculture for the encouragement and promotion of that industry, we quote again from the excellent report above referred to, from the testimony of Mr. John Lowe, Secretary of the Department. When speaking of the work done by the Department, he says: "The first in order in the enumeration of its functions is agriculture. There has, however, been no general vote for the purposes of agriculture. There have been special votes for particular branches—for instance, cattle quarantine and inspection, the gathering of statistics in certain particular cases, and also grants to exhibitions. Hitherto, these have comprised the whole functions of the Department in relation to agriculture." Much good has doubtless been accomplished by the measures which have been carried out by the Department, especially the prompt action taken in preventing the spread of disease among animals; but when we consider the enormous interests involved in agricultural pursuits, and the fact that they afford employment for so large a proportion of the population of the Dominion, it is evident that increased attention might profitably be given to all the important subjects on which the prosperity and advancement of this great national industry depends.

As an indication of the rapid extension of the Canadian trade in stock, dairy products, poultry, eggs and fruit, attention is invited to the following compilation of figures kindly furnished by Mr. Lowe, Secretary of the Department:

EXPORTS.

Year.	HORSES.		CATTLE.		SHEEP.		BUTTER.	
	Number.	Value.	Number.	Value.	Number.	Value.	Lbs.	Value.
1874....	5,399	\$ 570,544	39,623	\$ 951,269	252,081	\$ 702,564	12,233,046	\$ 2,630,305
1875....	4,382	460,672	38,968	823,522	242,438	637,561	9,268,044	2,337,324
1876....	4,299	442,338	25,357	601,148	141,187	507,538	12,250,066	2,540,694
1877....	8,906	779,222	22,656	715,750	209,899	583,020	14,691,789	3,073,409
1878....	14,179	1,273,728	29,925	1,152,334	242,989	694,337	13,006,626	2,882,237
1879....	16,629	1,376,794	46,569	2,096,396	308,093	988,045	14,307,977	2,101,897
1880....	21,393	1,880,379	54,944	2,764,437	398,746	1,422,830	18,535,362	3,038,069
1881....	21,993	2,094,037	63,277	3,464,871	354,155	1,372,127	17,649,491	3,573,034
1882....	20,920	2,326,637	62,106	2,256,330	311,069	1,238,957	15,161,839	2,936,156
1883....	13,019	1,633,201	66,896	3,898,028	304,474	1,388,056	8,106,447	1,705,817
1884....	11,595	1,617,829	89,263	5,681,082	304,403	1,544,605	8,075,537	1,612,481
1885....	12,310	1,640,506	144,441	7,508,043	335,307	1,264,811	8,145,310	1,577,428

EXPORTS.

Year.	CHEESE.		Eggs.		POULTRY.		FRUITS.	
	Lbs.	Value.	Doz.	Value.	Value.	Barrels.	Value.	
1874.....	24,050,982	3,523,201	4,407,534	587,599	79,224	51,084	128,915	
1875.....	32,342,030	3,886,226	3,521,068	434,273	49,787	63,397	176,295	
1876.....	36,024,090	3,751,268	3,890,813	508,425	74,317	84,107	170,005	
1877.....	35,930,524	3,748,575	5,025,953	534,891	48,307	77,888	194,942	
1878.....	38,054,294	3,997,521	5,262,920	646,574	67,448	53,213	149,333	
1879.....	46,414,035	3,790,300	5,440,822	574,093	90,890	87,101	157,618	
1880.....	40,368,678	3,883,366	6,452,580	740,665	141,034	146,548	347,166	
1881.....	49,255,523	5,510,443	9,090,135	1,103,812	133,693	334,538	645,658	
1882.....	50,807,049	5,500,868	10,499,082	1,643,709	149,804	212,526	540,464	
1883.....	58,041,387	6,451,870	13,451,410	2,256,586	161,229	158,018	499,185	
1884.....	68,755,423	7,251,989	11,490,855	1,980,197	192,908	51,019	173,048	
1885.....	86,579,834	8,902,115	11,542,703	1,830,632	175,889			

In 1885 a division was made in statistics by which apples are shown separately—

Apples, 242,164 barrels	\$607,156
Other fruit	33,667
Total	<u>\$640,823</u>

The recent diminution in the quantity and value of the butter exported may partly be accounted for from the fact that it is impossible to make the same milk do duty satisfactorily for both butter and cheese, since no sufficient market could be found for cheese made from skimmed milk. The very rapid expansion of the one department of dairy industry might reasonably be expected to result in a diminution of the other; nevertheless, it is highly probable that the relative inferiority of much of the butter exported has aided in bringing about this result, a view which is strengthened by the fact that the shipments in 1883, although less in quantity than those of 1885, brought \$128,000 more.

That so much has been done independent of any direct stimulus from the Department of Agriculture, is strong proof of the industry and enterprise of the farming community, and also of the capacity and adaptability of the soil and climate of the Dominion for still more extended work. Surely the fostering care of the Government should be given in aiding farmers to solve the many difficult problems which are invariably associated with agriculture, and are increased and intensified by the varying conditions of our climate and soil.

IV.—GENERAL CONCLUSIONS AND RECOMMENDATIONS.

PRELIMINARY.

From the facts which have been presented in the preceding pages regarding the expenditure connected with agricultural education in teaching colleges in America, added to the necessary cost of equipping the various institutions, it is evident that the outlay is very large in proportion to the number of persons directly benefited. Further, it has been shown that agricultural experimental stations have been of very great service in supplying much needed information and stimulating progress in agriculture wherever they have been established, and that these good results have been and are being brought about at comparatively small cost. In Canada agriculture may be said to lie at the foundation of the nation's prosperity, and involves interests of such magnitude and importance that any reasonable expenditure might well be incurred, provided the results were likely either to add directly to the profits of the tiller of the soil, by enabling him to increase the products of his land, or to save him from some of the losses incident to want of knowledge or experience. The consideration of so important a subject should be no longer delayed, but since any very large outlay at the commencement might be injudicious, it would perhaps be better to consider first the most pressing needs, and provide for them as soon as practicable, leaving the important subject of agricultural education in colleges for future consideration.

The following plan or outline of a proposed system of agricultural experimentation for Canada has been prepared, with the idea of securing for agriculture here the greatest good with the least possible outlay, and has been so arranged that it may be adopted in part without materially lessening its relative efficiency.

DIVISION OF EXPERIMENTAL AGRICULTURE.

PROPOSED ORGANIZATION AND MANAGEMENT.

There should be provided one central station, situated near the capital, the dividing line between the important Provinces of Ontario and Quebec, with not less than 400 acres of land, which should serve as an experimental station for these Provinces jointly. Here the climate represents the average condition of a large part of the settled portions of Canada, where all the cereals and many other field crops can be successfully grown, and where most of the best varieties of grapes grown in the open air ripen well, and many sorts of apples and other fruits are raised with advantage. At such central point all the different classes of experimental work might be conducted. There should also be one sub-station for the Provinces of Nova Scotia, New Brunswick and Prince Edward Island jointly, and one each for Manitoba, the North-West Territories and British Columbia. In the Maritime Provinces and in British Columbia 200 acres would probably be sufficient for the purposes of each station, but in Manitoba and the North-West Territories, where land is so abundant and cheap, there should not be less than a section of 640 acres belonging to each station, so that there might be land sufficient to carry on experiments in stock raising and forestry on such a scale as the circumstances of each case may require.

With the varying conditions of climate and soil necessarily associated with a stretch of territory covering 4,000 miles, from ocean to ocean, all now accessible by rail, a station on the Atlantic, another on the Pacific, with three intermediate ones, would be absolutely required if the work is to be carried on with reasonable efficiency. It would also be expedient that the Government should reserve, at suitable points in the North-West Territories, from the available and unoccupied Dominion lands, blocks of one, two or more sections each, for future experimental work in tree planting. The setting apart of these blocks of land for forestry purposes would not in any case be a loss to the country, since if they should only

be planted in part, this would increase the value of the remaining portion and also that of all the lands in the neighbourhood. By adding to the value of the adjacent lands they would partly pay for themselves, and at the same time prepare the way for extended experimental work if desired, as soon as young trees were available for the purpose.

The whole should be under the control of one head, known as Director or Chief, whose residence should be at the central station, and whose duty it should be to visit the sub-stations as occasion required, and, in conference with the managers of the sub-stations, arrange for the course and character of the work to be carried on at each, subject to the approval of the Minister of Agriculture. This arrangement would ensure desirable uniformity in the character of the work performed, and prevent the waste which would result from the unnecessary duplication of experiments.

Central Station.—At the central station there would be required, in addition to the Director, a superintendent of agriculture charged with the care of farm stock and the dairy and field experiments.

A superintendent of horticulture, who should conduct experiments in fruit and vegetable growing, in determining the vitality and purity of seeds, and have charge of the nursery and propagating houses.

A superintendent of forestry, who should direct all forestry experiments, and enquire into all questions relating to tree culture and tree protection in the Dominion.

An entomologist, whose duty it should be to investigate the habits of insects destructive to farm and garden crops, fruit, etc., as well as those affecting animals, with the view of testing such remedies as may be available for their destruction. He should also prepare such collections for the museum at the central station as would illustrate the insects injurious and beneficial to vegetation, and duplicate collections of a similar character as early as practicable for each of the sub-stations.

A botanist, to whom should be entrusted the special duty of investigating the injury done to field and garden crops, fruit

and forest trees, by the lower forms of vegetable life, such as fungi, rusts, moulds, etc.; to study the character and modes of growth of the noxious weeds prevailing in all parts of the Dominion, with the object of devising means for their subjugation or destruction. He should also take charge of the botanic garden or arboretum, and of that portion of the central museum illustrating vegetable products.

A chemist, to whom should be referred all questions relating to agricultural chemistry, such as analyses of fertilizers, the determination of the chemical constituents of any substances which it may be desirable to use in experimental work in feeding; to make analyses of milk in connection with experiments in dairying, of wheats, to determine their relative quality for milling; and to have charge of all other subjects requiring special chemical investigation in connection with the work being carried on at any of the stations.

A veterinary surgeon, whose services should be available when required for the treatment of diseases of animals at any of the stations, and whose duty it should be to study such diseases, and prepare and submit a yearly report thereon.

Provincial or Sub-Stations.—The officer required at each of the sub-stations would be a superintendent of agriculture and a superintendent of horticulture. The superintendent of agriculture to be chief of the station, subordinate only to the Director, and responsible to him for the proper government of the station, and for the due performance of all work directed to be undertaken. The superintendent of horticulture and all other employees to be subordinate to the superintendent of agriculture, and under his direction.

Reports.—The outlying stations to report to the Director as often as required, and the reports of the officers of all the stations to be presented through the Director to the Minister of Agriculture.

Nurseries and Propagating Houses.—At each station there should be established a nursery for the propagation of such varieties of plants, fruit and forest trees, etc., as may be desirable for the purpose of distribution, so as to rapidly

extend the area of experimental work. Each station should also be provided with a propagating house to facilitate these undertakings, and for the purpose of testing the vitality and purity of seeds for farmers and others.

Museum.—A general museum should be established in connection with the central station, where examples of all the varieties of produce raised from year to year should, as far as possible, be kept for reference and comparison, as well as for the instruction of visiting farmers. Specimens of injurious insects and their work, of injurious and beneficial birds, and other subjects of interest, should find a place here.

Other Duties of Officers.—In addition to the special duties already referred to, the officers of the several stations should be required to visit, whenever practicable, the public meetings of the farmers and fruit growers in different parts of the Dominion, for the purpose of conferring with them, and aiding in the discussion of the many problems connected with agricultural and horticultural pursuits.

Disposal of Produce.—In the management of the stations all the products should be sold, and a strict account kept of the returns. No officer or employee should be allowed to receive any portion of the produce without paying a fair value for the same.

Immediate Needs.—If the outline submitted be approved, it is important that the organization of the central station should be begun without delay; also a station in the North-West. The sections intended for future forest belts might also be reserved, and sites for the other stations secured as early as practicable. Possibly some arrangement might be effected whereby the cost of the sub-stations and their management might be jointly borne by the Dominion and the Provinces in which they are situated.

CONSIDERATIONS OF ADVANTAGE.

Improvement of Stock.—In the report of the Ontario Agricultural Commission, published in 1881, several qualified witnesses gave evidence in relation to the comparative value

of a well-bred three-year-old steer as compared with one of common stock. It was stated that, with the same quantity and quality of food, there would be an average difference in the market value of the well-bred animal of about \$30. If the breeding of better stock could be made more general, and but one-third of the estimated gain be made (\$10 a-head), a reference to the table of exports will enable the reader to calculate the saving which would be effected.

In all the Provinces there are townships where improved stock is seldom seen, and where farmers do not appear to be fully aware of the importance of introducing it. Some effort should be made to remedy this defect.

The opinion has also been advanced that in the ordinary breeding of sheep, if a proper selection of stock were made, 5 per cent., at a moderate estimate, would be added to the value of the carcass, and an additional pound of wool to each fleece. Farmers who pay no attention to breeding get an average of about 5 pounds of wool per fleece; those who make this subject a matter of some consideration and practice get from 6 to 7 pounds, and fancy breeders 9 to 10 pounds. Good feeding also gives a desirable lustre to the wool. Slovenly farming always leads to loss, and in this particular good breeding and careful management will result in good wool and good mutton.

In the more general improvement of horses and of swine, similar beneficial results might be obtained.

Poultry and Eggs.—By reference to the statistics given of the exports of poultry and eggs, it will be seen that the egg trade has increased enormously, and will, on account of the constant and general use of eggs, admit of almost unlimited expansion. The results of experiments with different breeds of fowls, for the purpose of ascertaining their relative merits, would be of great use to the agricultural community everywhere.

Dairy Products.—Since the general introduction of the factory system, cheese made in Canada has acquired an excellent reputation, owing to the uniformity of its character, and

meets with a ready sale at fair prices; at the same time, the quantity exported has increased to a remarkable degree. On the contrary, the exports of butter have slightly decreased, partly, it is said, owing to inferiority being in most localities the product of individual and unskilled labour. Since Canada is one of the best countries in the world for dairying, why should not our butter rank equal in quality and demand with the cheese? Evidence is not wanting to show that wherever creameries have been established the price of this product has been enhanced, in consequence of its uniformly good quality.

Prof. Arnold, of Rochester, estimates the annual loss to Canada, on account of the inferior quality and low price obtained for our butter, at five millions. Much loss might doubtless be avoided were creameries to be established in all the principal butter districts.

Grain Crops.—All cultivated cereals manifest, sooner or later, a tendency to deteriorate or run out; some much earlier than others. New varieties freshly introduced into a country often show great vigour and a high average of productiveness. Hence the importance of introducing new or untried sorts, and of the exchange of seed between localities having different conditions as to climate. Spring wheat has been for some years past a comparative failure in Ontario, producing, it is said, of late, an average of 12 bushels, as against a former yield of nearly 20 bushels. This is attributed to various causes, such as climatic changes, exhaustion of soil and insect pests. All these probably have some part in the result, yet it is likely that the deterioration is an important element in the case. More knowledge as to the proper rotation of crops, more thorough tillage and thorough drainage, would materially aid in advancing productiveness.

When we consider that a single grain of wheat carefully grown as a separate plant will yield an average of about three hundredfold, and how small compared with this is the ordinary yield in field culture, it is evident that there is abundant room for experiment and improvement as to methods of cultivation and treatment. The results of some researches

are of such a nature, that after definite conclusions have once been reached and published, there is no special need of their being repeated. Not so with the growth of agricultural products; the circumstances of climate and soil are so variable, and changes in the character of plants so frequent, that experiments may be constantly conducted with profit.

Recent researches in Russia, lately published in St. Petersburg, demonstrate the fact that wheat grown in the northern provinces of that empire ripens in less time than that grown in the southern, the difference being about sixteen days. How much of this difference is due to variety has not been determined, but there is no question that could we obtain for our vast wheat fields in the North-West earlier ripening varieties of good quality, the area of wheat culture would be extended, and the benefits resulting difficult to overestimate. Other field crops could, in all probability, in like manner be extended.

Fruits.—There is no question that most of our best varieties of small fruits would succeed well in many of the northern townships of our older Provinces, where they are, as yet, but little grown, and equally well in many localities in the North-West. From the experience related regarding the hardy Russian fruits in Iowa, it is highly probable that many of these also could be successfully cultivated in the same districts—not only apples, but pears, plums and cherries also. The early introduction of these fruits would be highly appreciated.

In the more favoured sections of our Dominion we have to consider not only the variableness of the existing climate, but must endeavour to prepare for changes which will probably occur, sooner or later, from the deforestation of the country. Last winter the extreme cold killed a large proportion of the fruit trees in many parts of Ohio and Michigan and in southern Illinois; in the latter district it is estimated that at least one-third of the apple trees were ruined, and some orchards are reported as entirely destroyed. Such experiences point to the importance of introducing varieties possessing great hardiness.

The fruit trade of Canada is rapidly increasing. It is ten-fold greater than it was a few years ago, and with proper selection of late keeping sorts, and the more general introduction of fruit evaporators, the trade might be almost indefinitely extended.

Insects.—Deficiencies in crops often arise from the depredations of insects. The yearly loss in Canada from this cause is very large, almost every farmer suffering from it to some extent. Such losses cannot be entirely prevented, but might be greatly lessened by the diffusion of more general information on the subject. Were a skilled entomologist appointed, whose duty it would be to visit districts where insect plagues occur, and give all the information obtainable as to the best preventive and remedial measures to adopt, the annual losses might be greatly reduced.

Fertilizers.—The establishment of a chemical station in connection with the central experimental farm would provide the means of thoroughly testing and establishing the value as a fertilizer of Canadian mineral phosphates, and undoubtedly aid in developing this important industry. Ashes are shipped in large quantities from Canada to the United States, where they are sold as a fertilizer, at a cost of from 25 to 33 cents a bushel. Canadian farmers hesitate to pay 10 cents per bushel. If the actual manurial value of ashes on farm and garden crops was demonstrated to our farmers, it is altogether probable that this useful article would be consumed at home.

A few years ago Canada had important belts of wheat lands east of Montreal. What has become of these? An indifferent and careless system, or lack of system, has prevailed in those districts; many crops of wheat have been grown in succession, and little or nothing done to replace the elements taken from the soil. This has led to its exhaustion to that extent that wheat growing no longer pays; a judicious system of fertilization and rotation of crops would doubtless restore the fertility of such worn-out lands.

The character of the work involved in the complete analysis of fertilizers is such as to require special forms of apparatus

which are complex and expensive. Appliances of this character would be needed in the laboratory at the central station for the special work to be undertaken there; and when that department was properly equipped, all the work of this nature required for the Dominion could be efficiently and economically done there. The saving which would be effected in the fees which under the existing law are to be paid to the public analysts, would go far towards defraying the expenses of the chemical section of an agricultural station.

Botanic Garden.—It has long been a reflection on Canadian taste and progress that we have no botanic garden in the Dominion. In Australia and India there are several such gardens supported by the Government. Botanic gardens have also been long established in Ceylon, the Mauritius, Jamaica, and several other of the West India Islands. Canada is, indeed, the only important British colony where such an instructive institution is wanting. In such gardens, trees are tested as to their hardness, for the production of timber, for their bark for economic purposes, and for their fruit, and all sorts of medicinal and other flowering plants are grown. There all the native trees, shrubs and flowers of the Dominion could be brought together as far as conditions of climate would permit, and new and useful species introduced and propagated. Such a garden would be a very instructive feature in connection with the proposed central experimental station, and could be carried on there at a relatively small cost.

General Unfulfilment.—The agricultural experimental farms, properly conducted, would soon become bureaus of information for all who are concerned with agriculture or horticulture, which the farmer and fruit grower should be encouraged to visit and inspect the work going on, and where they should feel free to report regarding such difficulties as they may experience in the course of their work, and seek information from the officers in charge.

As the success of this undertaking would depend mainly on the skill of the men entrusted with the work, and the earnest-

ness with which they engaged in it, all appointments should be well considered, and none made without satisfactory evidence being given as to the fitness of the individual for the work assigned to him. With a view to economy at the outset, and until the requirements of the stations were such as to demand the full staff, some of the appointments might be deferred, and others, such as the superintendent of agriculture and horticulture, and entomologist and botanist, combined.

OPINION OF DR. GEORGE M. DAWSON.

Dr. G. M. Dawson, Assistant Director of the Geological and Natural History Survey of Canada, whose wide reputation as a careful and accurate scientific observer adds weight to any opinion he may advance, having spent the greater part of the past twelve years in exploring the North-West and British Columbia, and during this time acquired an intimate knowledge of the conditions which prevail there, thus expresses himself, in a communication addressed to the Minister of the Interior, when asked for his opinion regarding the propriety of establishing agricultural experimental stations in Manitoba and the North-West:

Memo. on Experimental Agricultural Stations.

OTTAWA, 27th February, 1884.

"In connection with the proposed establishment of an experimental agricultural station or stations for Manitoba and the North-West, I beg leave to offer the following suggestions, based upon personal acquaintance with the country during my connection with the International Boundary Commission and Geological Survey since 1873.

"In the establishment of such stations it would appear desirable to keep two main objects in view:

"1. The introduction and careful trial of all species of trees, shrubs, cereals, grasses, fruits, etc., under the varying conditions of soil and climate found in different parts of the country, attention being directed specially to the Provinces of Quebec and British Columbia, the Northern and Western

States and the interior portion of Europe, as sources from which plants and seeds likely to be of special value may be obtained. In connection with this function should also be included experiments as to the rate of growth and best means of propagation and cultivation of native trees and useful plants; and further, the publication and general distribution of the results of these and other experiments in the form of reports.

"2. A second and very important function should be the propagation and cultivation, on a large scale, of the more valuable and quick growing timber trees, and their gratuitous distribution, or sale at the lowest possible price, with the view of encouraging extensive tree planting on the great plains. To this may be added the propagation and distribution of such new or improved varieties of fruit trees, cereals, etc., as may prove to be adapted to the country.

"For the second class of objects a single station for Manitoba and the North-West might suffice, though the existence of two or more stations would greatly facilitate the distribution of trees and plants. For the first, or purely experimental class of objects, it would appear to be almost absolutely necessary, in view of the diversity of soil, climate and elevation in this great region, to establish two or more stations. In the event of the establishment of one station only, it might, I believe, best be placed in the western portion of the Province of Manitoba. If two stations be established, one might be selected in the Red River plain, the second in the vicinity of the 104th meridian, near the Touchwood Hills or Qu'Appelle Valley. I believe, however, that three is the least number of stations which would satisfactorily serve the objects in view, and would suggest that in addition to the two last mentioned, a third should be placed either in the vicinity of Calgary or near Edmonton.

"In no event should the proposed stations be placed in the river valleys, as owing to their great depth the conditions found in these differ considerably from those of the general surface of the plain. It would also be desirable to select spots for these stations where belts or groves of trees already

exist, such as to form wind-breaks, and afford the shelter necessary for the proper cultivation of seedlings, etc.

"To achieve their proper degree of usefulness, such experimental agricultural station or stations should be under the superintendence of one experienced scientific agriculturist, besides those incident to immediate management of the stations, whose duty it should be to obtain suitable plants and seeds for experiment from all parts of the world in which such are likely to be found, to familiarize himself with the results of similar experiments elsewhere, and to publish the information so obtained with that resulting from his own experiments, for the guidance of farmers and others in the North-West. Should two or more stations be decided upon, it would probably be found most convenient for the scientific superintendent to have that in the Red River valley under his immediate supervision. This station might be made the principal one for the reception and distribution of plants and seeds to those farther west. The western stations might be placed in charge of intelligent practical farmers, and occasional visits of inspection made to them.

"In conclusion, I may be allowed to refer to the recommendations as to tree planting in the North-West contained in my report on the geology and resources of the 49th Parallel, published in connection with the Boundary Commission expedition of 1873-74.

"G. M. DAWSON."

Remarks.—Since cheap railway and water conveyance of agricultural products from distant countries is rapidly changing the economical conditions of successful agriculture in many parts of the world, it is of the utmost importance that all those who are interested in the cultivation of the soil in Canada should endeavour to remedy all that is faulty in practice, or wasteful in effect, and to introduce new methods and new products, as far as they are likely to be profitable, and thus increase the chances of our being able to retain the position we have acquired as producers and exporters of farm produce. A relatively small proportion of the land, even in

our most advanced Provinces, is under the *best* of culture while self-interest and the circumstances of our position demand that we should make the best of everything we possess. Liebig has well said that "the prosperity of any nation depends much on the condition of its agriculture," and to produce the best results, practical skill must be associated with suitable information. Canada has a climate in many respects favourable, and a soil in many districts unsurpassed in fertility, advantages which, if properly utilized, will enable her to continue to furnish from her surplus for the millions in Europe food products of prime quality. To aid in this good work every effort should be put forth, both by the Dominion and Provincial authorities, to place within reach of willing hands all needed information, and also supplies of such economic products as will be likely to add to the profit and attractiveness of agricultural pursuits.

FORESTRY.

There should be a competent forester in charge of this department, one who thoroughly understands what is needed, and under whose direction all work connected with the forest industries of the Dominion should be carried on. Such would include experiments in reclothing denuded land, testing the comparative value of our native trees, also of those from all other parts of the world, where similarity of climate or other circumstances render it probable that they will prove useful. It would also include the propagation of trees of economic value for general distribution.

GENERAL SUMMARY.

The following is a general summary of the work which it is desired should be undertaken:

(a.) Conduct researches and verify experiments designed to test the relative value, for all purposes, of different breeds of stock, and their adaptability to the varying climatic or other conditions which prevail in the several Provinces and in the North-West Territories;

(b.) Examine into scientific and economic questions involved in the production of butter and cheese;

(c.) Test the merits, hardiness and adaptability of new or untried varieties of wheat or other cereals, and of field crops, grasses and forage plants, fruits, vegetables, plants and trees, and disseminate among persons engaged in farming, gardening or fruit growing, upon such conditions as are prescribed by the Minister of Agriculture, samples of such surplus products as are considered to be specially worthy of introduction;

(d.) Analyze fertilizers, whether natural or artificial, and conduct experiments with such fertilizers, in order to test their comparative value as applied to crops of different kinds;

(e.) Examine into the composition and digestibility of foods for domestic animals;

(f.) Conduct experiments in the planting of trees for timber and for shelter;

(g.) Examine into the diseases to which cultivated plants and trees are subject, and also into the ravages of destructive insects, and ascertain and test the most useful preventives and remedies to be used in each case;

(h.) Investigate the diseases to which domestic animals are subject;

(i.) Ascertain the vitality and purity of agricultural seeds; and

(j.) Conduct any other experiments and researches bearing upon the agricultural industry of Canada, which may be approved by the Minister of Agriculture.

The whole respectfully submitted.

WM. SAUNDERS.

LONDON, Ont.,

February 20th, 1886.